

VOL XX • NO. 1 • JANUARY 1982

# **DEVELOPMENT DIGEST**

The DEVELOPMENT DIGEST is prepared for the Agency for International Development by the National Planning Association, a private, non-profit organization in Washington, D. C.

We would appreciate comments of an editorial nature and suggestions of material for possible inclusion in the DIGEST.

Please address:

Editor: DEVELOPMENT DIGEST  
National Planning Association  
1606 New Hampshire Avenue, N. W.  
Washington, D. C. 20009

The material included in the DIGEST adheres faithfully to the sense of the original. It does not, however, indicate omissions, minor editorial changes, etc. For scholarly purposes, the original source should be consulted.

Inclusion of material in the DEVELOPMENT DIGEST does not imply that the opinions and conclusions expressed herein are those of the United States Government or of the National Planning Association.

Except where otherwise noted, the material in the DIGEST may be freely reproduced in Latin America, Africa, and Asia (except Japan), either in English or in translation, or may be adapted, provided credit is given to the author and original source, and further provided that the sense of the original is not distorted. Where material carries a copyright notice, this notice must also be included in the credit citation.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 2, 1966.

---

For information on how to obtain the DIGEST, see inside back cover.

# **DEVELOPMENT DIGEST**

A quarterly journal of excerpts, summaries and reprints of  
current materials on economic and social development

Prepared by

**THE NATIONAL PLANNING ASSOCIATION**

A private nonprofit research organization publishing reports on  
domestic and international economic issues.

Editor, Dr. Gordon Donald; Associate Editor, Michael R. Whiteman;  
Digest Secretary, Dianne C. Wright

For distribution by

**THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT**

through AID Missions or Embassies in developing countries.

For information: Bureau for Program and Policy Coordination, Agency  
for International Development, Washington, D.C. 20523, U. S. A.



CONTENTS

---

Volume XX, Number 1

January 1982

---

AGRICULTURAL CREDIT

COOPERATIVES AND CREDIT--A RE-EXAMINATION B. J. Youngjohns	3
SUCCESS WITH GROUP LENDING IN MALAWI Walter Schaefer-Kehnert	10
MONEY AND COMMODITIES: THEIR INTERACTION IN A RURAL INDIAN SETTING Barbara Harriss	16
THE POLITICAL ECONOMY OF AGRICULTURAL CREDIT: THE CASE OF BOLIVIA Jerry R. Ladman and Ronald L. Tinnermeier	24

LIVESTOCK

POTENTIAL OF SHEEP AND GOATS IN LESS DEVELOPED COUNTRIES C. Devendra	35
NOT ALL ENDANGERED SPECIES ARE WILD Charles Hickman	50
EMBRYO TRANSFERS Judith Randal	56
RAISING CHICKENS IN THE BUSH Stephen Frye and Donna Gessell-Frye	61

WOMEN AND TECHNOLOGY

WOMEN, TECHNOLOGY AND THE DEVELOPMENT PROCESS Krishna Ahooja-Patel	79
--	----

WOMEN AND TECHNOLOGY (Con't.)

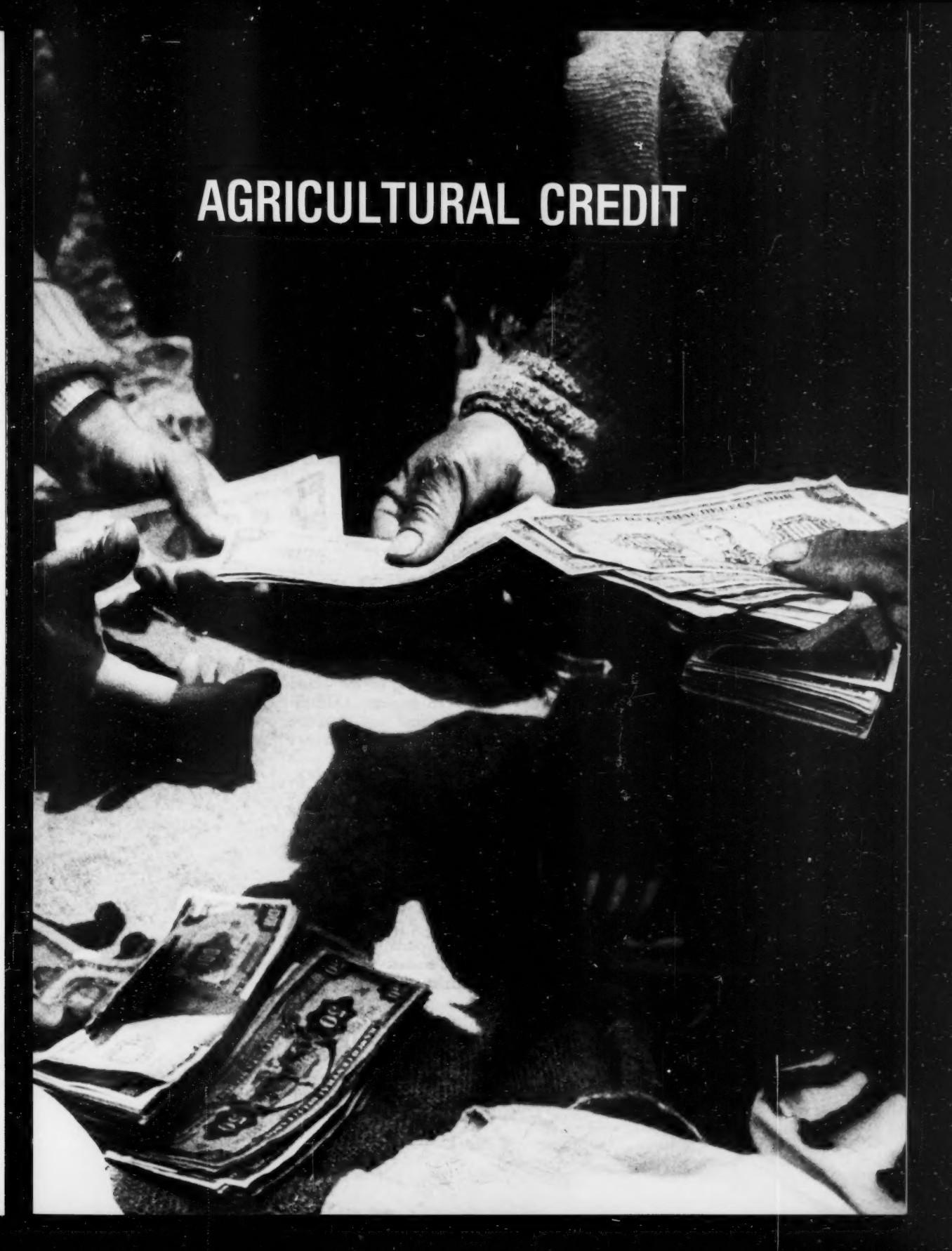
APPROPRIATE TECHNOLOGY FOR RURAL AFRICAN WOMEN Marilyn Carr	87
JAVA, INDONESIA: THE INTRODUCTION OF RICE PROCESSING TECHNOLOGY Melinda L. Cain	99
NEW TECHNOLOGIES FOR FOOD-RELATED ACTIVITIES: AN EQUITY STRATEGY Irene Tinker	105

PRIVATE ENTERPRISE

PRIVATE ENTERPRISE AND DEVELOPMENT Gordon Donald	116
---	-----

Money values will be expressed in U.S. dollars unless otherwise specified. The spelling "tonne" will be used to indicate metric tonnes (1000 kilograms), and "ton" will refer to traditional U.K.-U.S. tons (2000 lb. or 2400 lb.).

# AGRICULTURAL CREDIT



ACCESS TO AGRICULTURAL CREDIT  
IS ESSENTIAL FOR IMPROVING  
AGRICULTURAL PRODUCTIVITY AND  
RURAL STANDARDS OF LIVING.  
(PHOTO: FAO -- S. LARRAIN)

## **Cooperatives and Credit—A Re-examination**

B. J. Youngjohns

[Cooperatives in the Third World have been instruments of government policy rather than business-minded organizations servicing members. A common type of cooperative is the single-purpose farm credit society, which is often a losing business proposition. Credit unions and multi-purpose cooperatives have done much better.]

Within the Third World, the modern cooperative movement originated in India around the turn of the century. Although other types of cooperative were considered, a conscious decision was taken by the British authorities to give first priority to agricultural cooperative credit societies loosely based on the Raiffeisen model in Germany. The Rochdale system of consumer cooperatives, which had been quite successful in Britain since 1844, was specifically rejected as being more suitable for urban than rural conditions and as too sophisticated for India at that stage. The Cooperative Credit Societies Act of 1904 provided only for cooperative credit societies. The Cooperative Societies Act of 1912 permitted the registration of other types of cooperative, and became a model for cooperative legislation throughout the (then) British dependencies and in many other countries as well. It set the pattern of a cooperative movement under the supervision of a government department, headed by a Registrar of Cooperative Societies, and established a tradition of viewing cooperatives not so much as worthwhile in themselves or to their members but as instruments for public policy. This "instrumental" approach to cooperatives has persisted and has spread throughout the world, having been taken up by postindependence national planning and development offices, and by the bilateral and international aid agencies.

Mr. Youngjohns is deceased. He was with the British Ministry of Overseas Development, London.

The central contention of this paper is that, no matter how worthy a government's intentions, the instrumental approach to cooperatives is mistaken and is the root cause of failure and disappointment. It misconstrues the fundamental principles on which a cooperative is based. The allegation sometimes heard that the colonial power uncritically tried to transplant an organizational form from industrial Britain to rural India and Africa misses the point altogether. This is precisely what they did not do--if they had done so, the result might well have been better. To develop this argument, it is necessary to look again at some of the basic defining principles.

#### A Cooperative Is a Business

A cooperative is a voluntary, democratically controlled association of people with the purpose of conducting some kind of business. Voluntary associations are established for all kinds of social, political, cultural, recreational, or defensive purposes; a cooperative differs from others in being an association especially set up to go into business. Once established and registered, the cooperative becomes a body corporate, with perpetual succession, and it belongs to the class of business firms.

The distinguishing feature of a cooperative business is that it is owned by its members who are either its customers, or, in the case of production cooperatives, its employees. Concentrating on the former for the sake of clarity, it follows that, since the members are the customers, the cooperative must be concerned with promoting, not only its own business interest, but that of its members as well. A balance has to be maintained between the two: a cooperative should aim to be a sound business, but not at the expense of its members; and it should promote its members' interest, but not at the expense of its own business.

#### Cooperatives and Profit

A cooperative is a business, and the test of success in business is profitability. It is sometimes argued that a cooperative does not make a "profit" in the usual sense. Whatever name it is given, a cooperative like any other business must make it; if it does not, it will not survive --without external support. The difference between a cooperative and a privately owned business lies in what it does with the profit once it is made. Profit or surplus in a cooperative is either (a) plowed back as reserves, or (b) distributed proportionally to members as bonus. When operated properly, this system has great economic strength. It provides for interest to be paid on capital sufficient to attract investment shares; it builds up reserves; and through the patronage bonus of a consumer cooperative, it attracts customers. If the members are encouraged to leave some of their patronage bonus on deposit, this is a further method of building up capital.

In order to be profitable in the first place, and bearing in mind the need to keep a balance between the cooperative's interests and that of its members, the cooperative should generally operate at normal market prices. The record of cooperatives in the Third World, however, shows how this basic principle has been disregarded, usually because of the government's instrumentalist approach. Marketing cooperatives have been required to operate within narrow margins laid down by marketing boards and governments, for example, while credit cooperatives have always been required to lend at artificially low rates of interest.

#### Credit as Business

Much of the discussion heard on the subject of credit gives the impression that it is some kind of charity or system of welfare. But credit is a commercial concept: banks offer credit because they make profits from the interest earned; merchants give credit because it increases the demand for their wares. If there is a case for "helping" small farmers, over and above what is commercially sensible, it should be done by grants and subsidies and not by credit. Credit belongs to commerce and should be practiced only if it can be made a commercial success. The real question is, then, not whether cooperatives can be used as instruments to get credit to the people, but under what conditions (if any) can cooperatives make credit into a successful business.

#### Single-Purpose Credit Organizations

The original cooperative introduced into India in 1904 was the Primary Agricultural Credit Society (PACS) whose sole purpose was to make loans. Later, the Cooperative Land Mortgage Banks or, as they are now called, Land Development Banks (LDB) were introduced to make long-term loans against mortgage security. In many countries, primary cooperatives do nothing else but lend money. The principle behind them is that a group of small farmers, if organized as a cooperative society, can borrow on better terms than the individuals borrowing on their own account.

After nearly a century of experience, it can hardly be denied that single-purpose credit, under any institution (not only cooperatives), is not good business. The record of direct government loans as well as loans through development banks, informal groups, commercial banks, as well as cooperatives, all tell the same story of overdues, defaults, and losses. In fact, the only one who has made a success of rural credit is the much-maligned village moneylender, and even he is usually in other businesses as well.

The following are some of the reasons why small-farm credit is a commercial loser: (1) High administrative costs. The work involved in appraising, supervising, recording, and recovering a small loan is not much less than doing so for a larger one, so the small loan cost is very much

higher in proportion to loan values. (2) High risk. Small farmers are bad risks. They are unused to handling money, do not keep accounts, are under social and family pressures to mix up the farm money with their own, and are prone to crop failures. They have few resources to cushion them and little to offer as collateral security. (3) Lack of equity involvement. With single-purpose credit, the borrowers have little or no equity stake in the lending institution, and therefore no sense of personal responsibility. In single-purpose credit cooperatives and similar institutions, loans are approved by committees who have no financial stake in what they are doing. (4) Low interest rates. Because of political or moral pressure, interest rates are usually below lending cost.

It is hardly surprising that large numbers of single-purpose credit societies have failed. It is significant that even in Botswana, where consumers and marketing cooperatives have been conspicuously successful, the experiment in single-purpose agricultural credit societies was a failure. The single-purpose credit society, and its variants, are consequences of two errors: (1) that cooperatives should be instruments of government policy, and not businesses in their own right; (2) that the simplest form of organization is the best to run. In business, diversification (up to the limits of management capacity) produces strength: it spreads the costs and it spreads the risk.

#### Savings and Credit Cooperatives (Credit Unions)

Nowadays, the best known savings-cum-credit cooperatives are the credit unions. Unlike single-purpose credit societies, they are firmly based on regular savings contributions by the members. The collectively-owned savings then constitute a fund from which the members can borrow. The security for loans is the savings of the borrower himself plus those of up to two other members whom he can persuade to act as guarantors. Under this system, the credit union is fully covered. Credit unions also use more conventional forms of security including collateral. Interest on loans is traditionally one percent per month, a rate which, at least until the recent inflation, was more than adequate to make the union profitable. When a profit is made, it is handled in accordance with cooperative principles.

There has been considerable success in establishing credit unions in Latin America and the Caribbean, where they are the most conspicuously successful of all cooperatives. They have, more recently, been introduced into Africa and there is evidence, for example in Cameroon and Lesotho, that they can be made to work. It would be a mistake to claim too much for credit unions; they do have their limitations, and there have been failures. Nevertheless, they do make much better commercial sense than the single-purpose credit societies, and, in the countries where they have become established, are found among the best examples of non-state enterprise by the not-so-well-off section of the population. While they

have received some aid, it has been much less than that for many other less successful organizations. It is significant that they are reasonably well managed without excessive government supervision.

The real debate about credit unions is not whether they work or not, but whether they are suitable for agricultural credit. The largest and most successful credit unions have been urban, or among rural salary and wage earners. The system of periodic savings works best among regular wage earners, especially where arrangements can be made for savings deposits and loan repayments to be deducted from the payroll. Small farmers do not receive a frequent or regular income, and the organization of regular savings or loan repayments is much more difficult. Nevertheless, there is some evidence that credit unions can be made to work outside plantations in rural areas; the core membership may well be school teachers, civil servants and the like, but the small farmers are brought in. There are difficulties, too, in making loans for agricultural purposes, since agricultural credit is risky. Committees approving loans know that their own personal money is at risk. This very self-sufficiency, which is the basis for their success, makes credit unions difficult to use as instruments for government credit policies. If a credit union accepts a large external loan, its self-reliance is undermined.

#### Multipurpose Cooperatives

A multipurpose cooperative provides two or more different classes of service to its members. There are many possible combinations, but the most relevant for this discussion is the cooperative for credit, input supply, and marketing. The member is supplied with fertilizer and other inputs on credit before planting; after the harvest he delivers his crop to the cooperative, which deducts the loan from the proceeds before paying him the balance. In the better organized, such as the coffee cooperatives in Kenya, there is also a savings deposit system, so that the member's passbook account is active throughout the year.

Some have argued that the borrower's crop is useful as security only if there is compulsory one-channel marketing. This view is too extreme. The multipurpose cooperatives in Gambia do not have sole purchasing rights over the crop, for example, but do have a consistently high record of loan recovery. On the other hand, even when there is a single-channel marketing requirement there are still means of evasion for the borrower who is really determined to default. The multipurpose system is, on the whole, less insecure than most others, and ought to be persevered with. There is evidence, too, that education can help: members can learn that it is not in their long-term interests to dodge repayment.

While the security argument is the one most quoted for the multipurpose system, it should also be recognized that a diversity of opera-

tions makes for a much more viable business. The costs of management are spread over a wider range of activities. A full-time bookkeeper can be afforded. There is a much more consistent cash flow. If credit is seen, as it should be, as a part of the whole business enterprise, some of the risk can be absorbed as operating costs on the supply and marketing business. If multi-purpose cooperatives give credit, they should do so as part of a profit-making business and calculate the risk as a business cost.

#### Security and Loan Discipline

It is frequently the practice for governments to enforce some kind of collective responsibility for loan repayment by not allowing a cooperative society to have a new loan until it has paid a stipulated proportion of its previous debts. While some kind of discipline is necessary, this method has the disadvantage of punishing the good individual payers along with the bad. Overdue debt may be perfectly respectable, provided the co-operative has built up the reserves to carry it and the occurrence is temporary. Persistent arrears, however, is evidence of commercial failure, and such cooperatives are not worth further credit.

Other types of security are land, chattel mortgages, and penal sanctions. Land is normally used as security for long-term loans; with default, the lending institution may become the proprietor of land which it cannot sell, or there may be great political difficulties in taking possession. Chattel mortgages could be used for farmers when the loan is paying for something durable, such as a cow or a piece of agricultural machinery. Penal sanctions are not so much a form of security in themselves as a reinforcement of other forms.

While on paper there are various potentially effective systems of security, there is in fact a widespread reluctance to enforce them. Under Indian cooperative law, a society can render a debt to the registrar of cooperatives as a dispute, and can get an award which has the force of a court judgment. The legal framework really is quite comprehensive. The failure to make use of it can only be explained by the fact that the money on loan does not usually belong to the society itself but has come from the government or a government institution, so that the committees and managers do not feel either their own risk or a sense of responsibility. When a cooperative is run as a proper business, it has a normal business's motivation to collect its debts and improve its cash flow.

#### Rate of Interest

The "Rochdale" cooperative principle of trading at current market prices and distributing any resultant profit or surplus as a patronage bonus has hardly ever been applied to agricultural credit. If it had been, the original agricultural credit societies would have charged the same rate as the moneylender, and (presumably) made a large profit which

would have been refunded after the end of the financial year. This would produce a genuine net going interest rate. It was impossible to do this in most countries because right from the beginning a "low" rate of interest was part and parcel of the whole government scheme. Since the farmer's alternative was to borrow from the moneylender anyway, and borrowers had to go back to him when their cooperative collapsed, the argument against market rates of interest had no ethical basis; but this is not the prevailing view. With short-term credit, the amount of interest is trivial, even if the annual rate is high; if the farmer cannot pay the interest, he cannot pay the principal either.

Artificially low rates of interest have been forced on the cooperatives and other credit institutions for political and pseudoethical reasons, and have pauperized entire credit systems, with only trivial and transient advantages to the borrowers. The whole credit system becomes static, and dependent on everlasting financial replenishments from government and international aid. The source of payment for credit should be the additional production which it ought to produce; if a loan does not result in gains to the borrower more than enough to repay it, plus the going rate of interest, it should not have been granted in the first place. Artificially low rates of interest are not only responsible for operational losses in the lending institutions, they are also the cause of corruption and misuse of loan funds. The richer and socially more powerful members of the community have an incentive to borrow because it is cheaper to do so than use their own funds or go through ordinary commercial channels, and they use their power to manipulate the credit allocation in their own favor.

#### Conclusion

It is not the business of this paper to examine the credit performance of noncooperative institutions, but a glance at their record will show that, in the same type of credit, it is no better. The truth must, surely, be obvious that unsupported low-cost agricultural credit is unsound business in itself. It mixes the commercial concept of credit with charity and welfare. If governments feel that it really is necessary for political, social, or macroeconomic reasons, they must be prepared to subsidize it ad infinitum. The best hope of establishing dynamic and self-supporting credit systems in rural areas is through commercially viable organizations such as credit unions, multipurpose cooperatives, and private enterprise.

[Edited extracts from *Borrowers & Lenders*,  
edited by John Howell, pp. 179-198. Copyright©, Overseas Development Institute,  
London, England, 1980.]

## Success with Group Lending in Malawi

Walter Schaefer-Kehnert

[The Lilongwe Land Development Program initiated a method of lending to small groups of farmers that has been highly successful, especially in repayment. Farmers' clubs formed to assist extension work have also dealt successfully with small-farmer group credit.]

The high cost of lending to individual small farmers is a major concern in rural development programs. In Japan and parts of Western Europe prior to their industrialization, with agrarian structures made up predominantly of small farms, this problem was solved through the formation of cooperatives. In addition to credit, these organizations provided farm input supplies and product marketing services at lower costs than those charged by private trade. Efforts to introduce such multipurpose cooperatives in developing countries have failed (with outstanding exceptions in South Korea and Taiwan), and attempts are being made to find simpler and more manageable "precooperative" structures that provide at least part of the services of the classical farmers' cooperative. One type of precooperative organization is that for group credit, which has been introduced in a number of countries in recent years but with limited benefits. The case of Malawi provides one of the few successful examples.

Shortly after independence, Malawi failed in its initial attempt to promote rural cooperatives. Because of this experience, integrated rural development projects made no use of farmers' cooperatives in their early operations, and it was not until 1973 that group credit was introduced in the pioneer Lilongwe Land Development Program (LLDP), with the objective of reducing the costs of lending.

Dr. Schaefer-Kehnert is with the  
Economic Development Institute  
of the World Bank, Washington, D.C.

Farmers' cooperatives typically have several hundred members, whose dues can pay for a full-time secretary. Credit groups in Malawi, however, have only 10 to 30 members each and rely on unpaid management, which keeps lending costs low. The administrative staff usually consists of a chairman who provides the leadership, a treasurer who ensures trustworthiness, and a secretary who maintains the records of the group. There are more than enough volunteers to fill those positions, because the farmers are not fully employed on their small holdings, and the posts provide social prestige.

In group lending operations the security for credit repayment is usually provided by the joint liability of group members. If a default occurs on obligations to the lender, credit to the whole group is stopped until the default is corrected (and legal action against an individual member may also be taken). This may cause the entire group to be deprived of farm inputs such as improved seeds and fertilizers for the next growing season, which would result in a drop in production. To avoid such losses, the Malawi group credit scheme introduced a "security fund."

Borrowing farmers pay 10 percent of the loan amount as a deposit into a common fund that is kept in trust by the credit institution for the group. If there is a default, the shortfall is made up by drawing on the security fund. Farmers are then free to apply for new credit as soon as the fund is replenished. The group can also evict the defaulting members. Originally, 20 percent of a group's credit was to be deposited into a security fund, but Malawi experience indicated that a 10 percent deposit was sufficient to cover the risk.

A gradual accumulation of deposits over a period of years was originally planned, so that an insurance fund against crop failure could be initiated. The LLDP administration did not pursue this idea, however, because most farmers preferred to disband their groups after each season and establish new ones before the next season, so that the membership could be kept flexible. The flexibility was advantageous because as the number of credit groups quickly expanded, the membership of individual groups became increasingly concentrated in smaller locations. Village groups, and eventually extended families, chose to form credit groups. This structure guarantees a higher degree of loyalty from the members of a group because it avoids the anonymity from which cooperative societies with a wider membership usually suffer.

Prior to the formation of the credit groups, another precooperative structure had been promoted by Malawi's marketing agency, ADMARC. This organization encouraged the formation of input supply groups through which farmers could order their fertilizer by the truckload. Members of these groups received a discount on the price of fertilizer and could have it delivered to the location of their choice. This scheme had been highly successful and encouraged LLDP to embark on the group credit scheme.

In areas outside the main projects, the government extension service initiated a drive to form farmers' "clubs" for the purpose of group extension. These clubs established demonstration plots, and club members helped each other introduce modern technologies. In some cases members also undertook communal projects, such as village firewood plantations. Gradually the services of these clubs expanded to include group input supplies and group credit, so that now they are almost equivalent to multipurpose cooperatives. In 1980, there were approximately two hundred farmers' clubs, each with a membership of close to a hundred. Although the membership per club is larger than that of a credit group, only twenty or so members of a farmers' club actually take out loans in a season.

#### Group Credit Development and Performance

Group credit was first tried in the Lilongwe project, and then spread into farmers' clubs outside the project areas. Statistics on the operations in other areas are not available however. As of 1981, the government of Malawi has decided to extend group lending eventually to the whole country.

Table 1 shows the number of individual and group borrowers in the LLDP area from 1972/73 through 1978/79. Also shown are the number of credit groups and the average number of borrowers per group over this period. (The LLDP administration expected the number of credit groups to reach 2,000 in 1978/79, but the number actually fell short of the 1977/78 figure because the fertilizer being financed did not arrive on time in sufficient quantities.) There are now more group borrowers than individual borrowers, and it is expected that group borrowing will continue to increase rapidly. The government is even considering allowing only group credit in new development areas.

TABLE 1. LLDP INDIVIDUAL AND GROUP BORROWERS

Year	Borrowers in Thousands			Number of Groups	Borrowers Per Group
	Total	Individual	Group		
1972/73	21.1	21.1	--	--	--
1973/74	25.7	23.9	1.8	94	19
1974/75	25.1	20.5	4.6	242	19
1975/76	32.2	24.6	7.6	410	19
1976/77	36.8	23.5	13.3	670	20
1977/78	42.5	14.6	27.9	1,267	22
1978/79	51.5	23.1	28.4	1,217	23

Table 2 shows the loan amounts borrowed under the LLDP by individuals and farmer groups, the average loan per borrower, and repayment records. The total amount loaned has almost quadrupled over six years, and group credit climbed from zero to more than 50 percent of the loan portfolio.

The average amount borrowed per farmer is around MK30 (Malawi Kwacha 30 = US\$40) and does not vary significantly between individual and group farmers.

TABLE 2. LLDP INDIVIDUAL AND GROUP LOANS

Year	Amount of Loans			Loan Per Borrower		Repayment	
	Total	Individual	Group	Individual	Group	Individual	Group
	MK'000			MK		%	
1972/73	382	382	--	18	--	97	--
1973/74	481	460	21	19	12	98	100
1974/75	737	601	136	29	30	98	100
1975/76	859	624	235	25	31	96	99
1976/77	1,012	627	385	27	29	100	100
1977/78	1,292	453	839	31	30	100	100
1978/79	1,461	656	805	28	28	n.a.	n.a.

The repayment record for group credit--100 percent repayment in four out of five years--is most impressive. Repayment by individual creditors used to be at 96-98 percent, but this figure also rose to 100 percent in 1977/78 and 1978/79.

#### Outstanding Issues

The LLDP administration differentiated between individual and group credit by charging individuals 15 percent and groups 10 percent interest. There is no information available on what the actual cost difference is in administering the two types of credit. The project administration gives credit groups specialized training in self-accounting, so that eventually considerable costs are saved. If farmers have a free choice either to take individual credit or to join a credit group, the difference in lending costs should be reflected in the credit terms--assuming that there is no special reason to subsidize one form over the other. Therefore, plans are underway to investigate the cost difference between individual and group credit.

There appears to be no significant difference in the repayment records of individuals versus credit groups (Table 2). However, there are indications that the almost equal repayment record is achieved with much greater effort in collecting payments from individual farmers than from credit groups. This factor should be included in the cost comparison.

The security fund mechanism used in the Lilongwe group credit scheme is not utilized by the farmers' clubs because the clubs have other funds derived from members' dues and communal operations. These funds, however, are rather small and unlikely to give the same protection as the 10 percent security fund. From the point of view of simplifying credit administration, it would be desirable to apply the same credit mechanism in both the farmers' clubs and the credit groups.

There is no doubt that the farmers' clubs, with their greater continuity and the combination of group extension with group credit, are a higher form of precooperative organization. A distinguishing feature of farmers' clubs, for example, is that members not taking up credit still continue to participate in group extension. On the other hand, farmers' clubs are more difficult to organize than the single-purpose credit groups. Therefore, it might be practical to introduce a kind of graduation process under which credit groups may be promoted to farmers' clubs, and eventually to regular cooperatives.

In meetings held with several hundred members of credit groups and farmers' clubs, almost all expressed the desire to broaden the range of items that would be eligible for credit financing. Among the short-term inputs the demand was strongest for credit in cash to pay casual labor during the growing season. Most farmers' clubs also wanted to receive medium-term credit for farming implements and in particular for bullocks and dairy cows. These items are presently financed only with individual credit, and on a very limited scale because most farmers cannot offer acceptable collateral. The clubs feel prepared to guarantee the repayment of these loans.

One of the clubs has started making loans from its own funds on a limited scale. When asked whether the club would consider accepting savings deposits in order to further build up its funds and provide an additional service, the club members appeared receptive to the idea but were reluctant to make a firm commitment at first, as they were aware of the additional responsibilities that would be accepted. Members showed a definite interest, however, in making savings deposits. This idea appeared especially attractive when discussing the possible interest rates available if interest on deposits were determined by the lending rate minus the very low administrative costs of the clubs. As of late 1981, savings deposits had accumulated to a level that enabled one club to extend 86 loans based on deposited funds.

#### Conclusions

This experience with group lending in Malawi has proven that pre-cooperative institutions can be developed successfully in poor peasant societies, even in environments where efforts to develop conventional cooperatives have failed. Group lending in Malawi can be distinguished from conventional lending approaches by the following factors:

- The credit groups offer clearly defined economic incentives such as lower interest rates, price discounts on inputs, and relief from individual loan processing.
- The formation of groups is left to the initiative of the farmers; government assists but does not interfere.

--Formation and disbanding of groups is simple and nonbureaucratic.

--Membership in the groups is kept small.

--Management is provided by elected group members who perform their duties without pay, principally for social prestige.

--Operation is limited and simple.

--Members are fully liable for an individual default.

--Group security against default is provided by an advance deposit which is refunded with interest at full repayment of the loan.

It is interesting to note that these features coincide with the principles of Raiffeisen who founded the German cooperative movement more than a hundred years ago. When organizing the first primary societies among peasant farmers his principles were: limited and simple sphere of operations; unlimited liability of members; management by unpaid volunteers. Using these principles, the Raiffeisen societies established a reputation of credit-worthiness that enabled them to borrow from commercial lenders; only later did they broaden their sphere of operation to include input and output marketing, processing, and other services. Today they still handle more than 60 percent of all agricultural trade in the Federal Republic of Germany.

Thus, the group credit scheme in Malawi started with a concept that has a history of success. In line with historical experience, this pre-cooperative concept should not be considered an end in itself, but rather the preliminary stage of an institutional development that can expand and broaden into a genuine cooperative movement. Malawi's experience with a previous cooperative movement that failed--apparently while trying to accomplish too much in too short a time with too much political interference--should guide further development so that the same mistakes are not made again. It may be wise to use a graduated process, the final stage of which could result either in a savings and loan association or a multipurpose service cooperative.

[Edited extract from Quarterly Journal of International Agriculture (Zeitschrift fur Auslandische Landwirtschaft, Berlin), Vol. 19, No. 4, October-December, 1980.]

# Money and Commodities: Their Interaction in a Rural Indian Setting

Barbara Harriss

[This article examines a rural area in south India where the money market consists of private traders who compete actively for farmers' purchases or sales by offering them loans on favorable terms, of pawn-brokers, and of state cooperatives offering subsidized credit. State banks are actively lending to the traders so that they may relend to farmers; this results partly from government's effort to increase the use of fertilizers. One consequence of active competition among lenders is to keep many small farmers in operation who might not have survived without such access to credit.]

This analysis addresses itself to the complex nature of a rural money market in south India. Data are drawn from field research in 1973-74 on a random sample of 200 traders in agricultural commodities (rice), agricultural inputs (fertilizer and pesticides) and agricultural investment goods (pumps and irrigation accessories), and from random surveys of twenty village cooperatives and of two hundred paddy producers in twelve villages of North Arcot District of Tamil Nadu State. I examine the private rural money market; the money markets organized indirectly and directly by the State; the linkages between private and public finance, and between the money market generally and the market for agricultural commodities.

## The Private Rural Money Market

Evidence from agricultural traders. The unorganized money market is highly complex. There may be as many as 180,000 farmers in the rice producing eastern region of North Arcot who market paddy (unmilled rice)

Ms. Harriss is a Research Fellow in the Nutrition Policy Unit, London School of Hygiene and Tropical Medicine, London, England.

to some 2,300 traders. Traders said they lend in cash or kind to about half their customers. High and increasing demand for production and consumption credit enables traders to discriminate among clients. Private sector money is not necessarily a substitute for cooperative loans; it may be a complement: "If a man can't get a government loan, he's likely not to be able to repay my loan."

A farmer's eligibility for short term loans is determined by traders on criteria similar to those used by State-run cooperatives. Traders assess landholding, crop size, capital assets, and past repayment performance. The private money market is more physically accessible than is that of the State. A trader's shop is open from 6:00 a.m. to 10:00 p.m., loans are obtainable with no paperwork, and the request is usually speedily handled. No security has to be given, and borrowers can use the money for any purpose, agricultural or social.

Agricultural loans obtained on the private money market are rarely small. In the paddy and rice trades and in fertilizer dealing, the lower limits averaged Rs. 200. The largest loans to individuals were between Rs. 2,000 and 3,000, about equal to the maximum permitted by the cooperatives. Traders occasionally lent up to Rs. 10,000, but cultivators seeking large sums were usually advised by traders to apply to nationalized banks or "private parties"--the highly elusive, large-scale, full-time money lenders in the back streets of many market towns. Loan ceilings also varied with the size of the trader's business, smaller traders tending to lend to smaller farmers.

The average annual interest rate for loans was remarkably consistent at 13 to 14 percent, which was slightly above the current legal ceiling of 12 percent. The ways in which interest was paid, just as with the principal itself, were quite varied. Normal repayment was in kind after harvest, although loans for pumpsets allowed a longer repayment period. In some collecting centers, no interest was charged to those who supply the trader with more paddy than the repayment of their debt necessitates. In the town of Arcot an interest rate of 12 percent per annum was universal. In Arni and Tiruvannamalai wholesalers subtracted as interest between Rs. 0.5 and 2.0 per 75 kilogram bag of paddy from the market price, which amounts to a rate of 4 to 10 percent per year.

Interest rates climbed if a farmer repaid more than a month after harvest. It seemed that about one-fifth of all loans took longer than agreed to repay. Slow payers were not necessarily the smallest farmers, sometimes being large farmers who had reloaned borrowed money. In cases of late repayment, interest rates varied from 12 percent to 25 percent. The markets where funds were least available had the highest rates on overdue payments. Great social pressure, moral--and occasional physical--intimidation was exerted on slow payers, and traders exchanged

information on "bad risks." According to traders, an average of 5 percent of borrowers defaulted completely. Every trader allotted time and resources to attempt to retrieve his money, costs of potential litigation being weighed against the size of the sum to be lost.

Interest rates higher than the legal ceiling were often attributed to a combination of inelastic and rising demand, the costs of borrowing, and the costs and risks of credit administration. It has also been contended that high interest rates have a component of monopoly profit. This was obviously not the case in our study area, where competition among lenders was active.

A few traders attracted small savings deposits. The trader used this money in trade; he would reciprocate the farmer's good faith by giving him small quantities of money (Rs. 3 to 5 for a meal, medicine, or a bus fare) in lieu of interest payment.

Credit and moneylending do not appear to be the basis of an exploitative relationship between trader and farmer in North Arcot, partly because two main castes comprise both cultivators and traders. There are strong ties of kinship as well as money between town and country.

Pawnbrokers contributed to the private rural money market in competition with the nationalized banks, which also lent on pledged jewels. Compared to the banks, pawnbrokers offered greater ease of access, speedier service, easier valuation procedures, and larger loans in proportion to the value of the jewel. Pawnbrokers also charged higher interest rates, allowed thumb impressions, lent on jewels as well as on gold, and lent to any owners of jewelry without restricting loans to those with bank accounts as the banks do. Pawnbrokers were becoming an important source of cash for agricultural production, and the years since 1968 saw a massive increase in their number throughout North Arcot. Interest was higher than that charged by banks and traders, varying from 18 to 25 percent inversely with the size of loan.

It seems that this recent increase in demand largely came from poorer farmers seeking loans of Rs. 50 to 100 to pay agricultural labor, bullock hire, fertilizer, or pumpset repair; and to a lesser extent larger loans for well-deepening and for purposes such as weddings and gambling. Traders would not lend these sums. Demand is highly seasonal (January to May) so that money may be idle at other times; which is partially reflected in the interest rate. Although pawnbrokers are held in low regard by other lenders, they are a more accepted part of rural society than is the formal-sector lending institution.

The evidence we have builds a picture of a relatively competitive money market. On one occasion, because of high default rates and because of fears of State take-over of the grain trade, the Arni Paddy and Rice

Dealers Association of the largest traders decided to act collusively and reduce moneylending to farmers. It was the only association in the District to take such action, and by no means all traders complied. Flows of money from the local marketplace declined over 1973-74. Some traders, anticipating drought, used their spare funds to stock paddy to the legal limit and above. At the same time, credit from fertilizer dealers also dropped in volume, firstly because fertilizer had entered a phase of short supply and promotional credit was unnecessary, and secondly because overdraft facilities for traders did not increase when the price of fertilizer they sold more than doubled.

There was a marked result on the money market. Whereas in 1965 there were 10 pawnbrokers, in 1973 there were 72, and by 1974 there were 88. Within the pawnbroking trade, demand for money for agricultural purposes trebled in 1972-74, encouraging not merely a new intake of pawnbrokers but the emergence of minor government officials, teachers, and clerks as moneylenders, charging 18 to 25 percent. However, it is important to note that while the interest rates charged were illegally high, they were rarely equal to the net rate of return on capital from agricultural commerce, which averaged an estimated 24 percent. The money market is thus structurally flexible. Private intermediaries--traders, pawnbrokers, and jewelers--compete for the business of different types of cultivators, while traders' money substitutes for state loans for smaller farmers.

Evidence from Agricultural Producers. A survey of 200 paddy producers analyzed by B. N. Chinnappa and anthropological research by John Harriss lend support to the description above. Chinnappa's data, on borrowing and farm size, show that the proportion of farmers borrowing for cultivation expenses was very low among the bottom 14 percent cultivating less than one acre (0.4 ha.), while about half of all other farmer groups borrow. In the group taking loans, borrowed money contributed just under half of cultivation costs. Private credit sources, including village moneylenders and pawnbrokers who charge interest, chit funds with disguised interest charges, and friends and relatives who may or may not charge interest, grew less important than banks with increasing farm size.

We have noted that traders did not lend amounts below about Rs. 100, and that pawnbroking was becoming important at the poor end of the spectrum. Since the average loan was about Rs. 180 per acre, it is possible that small farmers were involved in borrowing from traders rather than village moneylenders. Consumption loans may be obtained from traders, and it is possible, judging from the increase in numbers of both agricultural traders and pawnbrokers, that moneylending is being increasingly concentrated in the towns. Certainly the moneylender is not so prominent in the villages, nor are interest rates so high, as in conventional characterizations of other areas of India.

Demand for money in agricultural production has greatly increased for two types of reasons, connected with two rather different forms of production. First, among larger farmers, money is simultaneously lent and borrowed, with interest rates and relative risks juggled in an effort to make a profit. This is known as "rolling," and the English word is used. Second, among small farmers, the demand for cash has increased. This reflects purchase of modern farm inputs including irrigation water, accommodation to increased insecurity, contingencies such as crop failure, the need to replace a team of draft animals or a pumpset coil, and desire for consumption goods.

#### The Role of State Financial Institutions

Indirect participation in the rural money market. The involvement of national banks in rural money markets began in North Arcot District in 1967, coinciding with the ending of a cooperative monopoly in fertilizer marketing and with the point in the fertilizer cycle when production exceeded demand and marketing agencies instituted vigorous competitive tactics. The financing of agricultural production by the State began in the form of credit sales at no interest to private fertilizer dealers or agents, who repeated the procedure with interest to farmers. A State-owned inputs distribution company was the first to experiment with this, soon followed by the private companies. At the height of this credit boom, a trader's security bore no relation to the loans which were extended, and by 1971 the distributing companies themselves had large debts. Repayment was slow, and many traders went out of business.

By 1973, however, credit competition had stabilized somewhat, largely due to the skillful intervention of the state through the big commercial banks which had been nationalized in 1969. An example of the terms of their involvement is seen in credit purchases by dealers in agro-inputs up to 80 percent of the value on goods bought for purposes of resale, up to a specified absolute ceiling. A dealer was also eligible for an equal quantity of 180-day crop production credit, both for his own crops and for those of farmers, with repayment after harvest. Dealers were required to deposit 20 percent of their sanctioned limit with the banks. They also had to offer their title deeds, hypothecated stocks, or promissory notes, and to pay interest at 10 $\frac{1}{4}$  percent. Dealers were strictly supervised, having to supply a monthly stock statement and submit to periodic inspection of accounts by bank agents and of stocks of fertilizer by representatives of the distributing companies. Dealers no longer had any privacy in their financial transactions with companies and banks.

In this situation of glut and severe competition, the balance of power shifted to the nationalized banks. The private distributing companies competed with each other for sales (and with the cooperatives as

well), while the banks operated virtually identical schemes through every company. Interest rates charged to farmers were unsubsidized and higher than for cooperative credit. This form of finance has been standard practice since 1972 in North Arcot District where private traders sell half of the fertilizer used. All licensed dealers were compulsorily involved, and up to 80 percent of the value of trade could be financed in this way.

The direct role of the nationalized banks. Private moneylending faces formidable competition by the state. The purely private money-lending activities of inputs dealers are swamped by credit extended by the nationalized banks through them. The banks also offer 18-day production credit directly to farmers with over two acres, at the rate of Rs. 250 per acre up to a ceiling of Rs. 1,000 to 2,500 depending on the bank. These standard loan limits were lower and the interest rates were higher than those of the Panchayat Union and cooperatives which also lend to farmers. The farmer had to prove ownership and show all production receipts. A bank manager explained that it was of course very large farmers who knew about this source of finance and used it, often for relending. They were often tardy in repayment, since these delays were not penalized by a rise in interest, and default was a major problem.

The role of cooperative credit. The major competitor with private trade remains the cooperative credit system financed by the Cooperative Bank, which is subsidized. As Chinnappa shows, the 47 percent of the 200 sampled cultivators in North Arcot who took loans got, on average, 32 percent of their production credit from cooperatives. Cooperative credit was disproportionately concentrated on larger farmers. In the sample, the share of cooperative loans in all production credit rose with farm size from 10 percent to 62 percent. A case study of an agricultural cooperative showed that, in the geographical area covered by the village cooperative, loans per person per season averaged Rs. 800 for cultivators with under 3 acres, while for those possessing more than 3 acres they averaged Rs. 2,300--above the official ceiling. Interest rates varied between 8.7 and 9.7 percent per year on postharvest payments, rising to 12.6 percent (the legal ceiling) for overdue payments.

Cooperative loan statistics for all village societies were obtained from the Central Cooperative Bank, Vellore. To a remarkable degree, co-operative credit operated where private credit was least abundant. In the District as a whole, cooperative credit amounted to just under half the quantity supplied by private trade, excluding pawnbroker loans for production. In spite of the State sector's advantages in low rates, other factors reduced its competitiveness: for example, the low interest rate charged was offset by other costs to borrowers. These included inefficient administration, lengthy application procedures, untimely arrival of credit, inflexibility of repayment procedures, and necessity for proof of collat-

eral as well as the cost of bribes. All this raised the effective cost of loans about to the level of those from private traders. Also, the ceiling of Rs. 2,000 on cooperative production loans forced the relatively few cultivators with land holdings in excess of 10 acres to seek extra funds elsewhere if needed. The outright default rate on production loans of 20 cooperative societies surveyed in the study area was 26 percent, rendering the defaulters ineligible for further production loans. Many of them were large farmers. During the election campaign in 1972, farmers were "promised" that a vote cast in the right direction would write off a loss.

The role of state lending to commodity traders. The state encourages the nationalized banks to lend to fertilizer dealers, but discourages loans to paddy and rice traders. However, this was unimplementable, and the financing of intraseason paddy and rice stocks is a secure and profitable form of investment for a bank. So wholesalers and millers may obtain bank loans if they wish. One much publicized case concerned a bank which lent large sums to pawnbrokers and to professional money-lenders in one of the towns in the District. Once this was discovered it was quashed, but there is no doubt that other such activities continue.

The result of such intersectoral linkages and competition is that the existence of cheap state credit increases the availability of money for agricultural production, and exerts a restraining influence on private sector interest rates. This social benefit cannot be quantified but ought to be borne in mind when assessing the social effects of the cooperative subsidy that mainly benefits large farmers.

#### The Results and Contradictions of Linked Finance and Commodity Markets

This complex money market and the limited expansion of agricultural production that it supports have enabled large numbers of small traders to maintain themselves in business, and to compete with each other and the big traders. One form which this competition takes is lending money to farmers at rather low interest rates. Thus the small trader allows the small farmer to reproduce himself and survive. Why are there so many small traders?

There seem to be at least six reasons why agricultural commerce is relatively crowded: (1) Commerce remains more profitable on the average than any other sector of this region's economy and continues to attract entrants. New entrants to trade come increasingly from the wage labor force of the commercial sector itself, as well as from producers of the commodities sold. (2) Commerce may also be crowded because of demographic expansion. Traders' families are slightly larger than those of the average peasant producer, and family members need employment. Joint family businesses become managerially unwieldy and often split to provide each son with control over resources and sources of funds for consumption

and reinvestment. (3) Joint family enterprises also split because tax legislation discriminates against multiple enterprises and joint family combines. There are powerful fiscal incentives for simple single-owner businesses, and many traders acknowledged having split firms for that reason. (4) The personal knowledge of clients necessary in moneylending also may set a limit to the number of clients any mercantile firm can scrutinize and maintain. (5) The state encourages easy entry into commerce in other ways. In North Arcot District the dominant form of intervention attempts to encourage competition through market regulation in an effort to reduce distributors' margins at minimum cost to public funds by trying to maximize numbers in trade. And (6) the central Government's priority for expanding the fertilizer industry to increase food production has led to a spawning of small inputs dealers with only limited scope for concentrating their capital. The international companies distributing fertilizer and pesticides compete through several separate networks of private dealers, through the cooperatives, and even through the State's Department of Agriculture.

The expansion of commerce in inputs itself increases the marketed surplus, which feeds back into commerce again. Competition among traders for farm commodities also takes the form of money lending at relatively low interest rates; in this market the effect on interest rates of subsidized cooperative credit from State-supported institutions has not been negligible. All this helps small and marginal farms to remain in operation and to expand production within limited spheres. At the same time, investment in trade is relatively attractive because of commodity price levels and the opportunity to profit from market imperfections, which are often the perverse result of state intervention. The structure which is involved in this circle--small farmers, a large number of traders, relatively cheap loans from competition in trade credit, and state intervention--reinforces itself and arguably constrains agricultural production over the long run. The tight link between the money market and the imperfectly functioning commodity market allows high return from joint operations in both markets, as trader and lender.

[Edited extract from a paper presented to the Workshop on Rural Financial Markets and Institutions, Wye College, Wye, England, June 1979.]

## The Political Economy of Agricultural Credit: The Case of Bolivia

Jerry R. Ladman and Ronald L. Tinnermeier

[Although agricultural credit programs are viewed as fundamentally economically oriented, they are very susceptible, indeed alluring, to LDC governments for political reasons. An example of credit as a political instrument in Bolivia is described. In such cases resources are allocated to satisfy political objectives, with less than optimum results for long-term development.]

There are five major reasons why the political economy of agricultural credit has become important. First, governments typically control the supply of formal agricultural credit, and they can strongly influence its distribution and allocation. Second, concessionary interest rate policy, which is almost ubiquitous in LDC agricultural credit programs, provides an attractive income transfer to borrowers. Third, when governments tolerate long-term delinquency default, as is not uncommon in LDCs, the non-repaying borrower receives a default income transfer. Fourth, when inflation is present, concessionary and income transfers are magnified. Fifth, the advantages of obtaining these transfers are sufficiently attractive that they can be used by governments to gain the favor of borrowers and, conversely, by borrowers to influence government.

Credit programs are particularly alluring for political purposes. First, they are easy to establish and administer. Second, they are very legitimate for economic objectives. Third, because monies are fungible and because of the hidden transfers, the true uses of such funds

The authors are Professor of Economics  
and Director of the Center for Latin  
American Studies, Arizona State University,  
and Professor of Economics, Colorado State  
University, respectively.

are difficult to identify. Thus, credit lends itself to being used for political purposes under the guise of economic development.

The extent to which credit allocation decisions are influenced by political factors, or vice versa, is difficult to ascertain in practice. The Bolivian case is particularly useful to study. This country is an archetype of underdevelopment and, as one of the world's poorest nations, has been a recipient of large infusions of foreign assistance. Moreover, the country is small enough so the flows in financial markets are more easily identified than in larger and more complex countries.

#### The Political Elements in Farm Credit

Commercial financial institutions in LDCs have shunned lending to agriculture because of the high costs and risks embodied in these loans. Thus, pressures arose to provide alternative sources of financing. The passivity of the agricultural sector suggested a supply-leading financial approach, and government agricultural banks were commonly established. When it became obvious that government institutions could not meet the needs of financing agriculture, means were sought to force the private sector to lend to agriculture. Central bank rediscount mechanisms, loan guarantees and loan portfolio requirements were common policies. Almost without exception all of these agricultural credit programs incorporated a feature transferred from the United States' Farmers Home Administration credit model: the low and concessionary interest rate. Foreign support for these programs is evident, both in the advice and in the capital supplied in volume by donor agencies. Little attention has heretofore been directed, however, at the tremendous political leverage that the concessionary transfer offers.

A framework for the political economy of agricultural credit. Figure 1 presents a countrywide demand curve  $DD'$  for credit from agricultural lenders to be used for agricultural purposes when interest rates are equalized throughout the economy. Assume that the prevailing real interest rate is  $r$ , and that farmers would want to utilize  $OC_1$  credit. Suppose, however, that the government subsidized agriculture by means of a concessionary interest rate,  $r'$ , for agricultural loans but left interest rates for non-agricultural loans at the previous levels. Two effects would occur. First, borrowers would increase the quantity of funds demanded for agricultural purposes from  $C_1$  to  $C_2$ ; and, if non-price rationing were not employed, they would simultaneously receive a subsidy or income transfer (the concessionary transfer) equal to the area designated by the points  $r'rab$ .

Second, since money is fungible, credit can be ostensibly borrowed for agricultural purposes but be diverted to non-agricultural activities such as consumption or investment. This gives rise to "agricultural illusion"--a situation where some agricultural loans have the appearance of going to that sector, but in fact are used elsewhere. With the relatively

lower interest rates for agricultural loans, it would be expected that borrowers would behave in this manner--especially those with multiple occupations and knowledge of their investment opportunities--and, the demand for credit from agricultural lenders would shift right to  $DD''$ . Borrowers would want to use  $OC_3$  quantity of credit to practice agricultural illusion, and the concessionary transfer now becomes  $r'rac$ .

If further concessions were granted, e.g.,  $r''$ , there would be yet further demand shifts to the right, e.g. to  $OC_3$  for farm credit. The horizontal distance between  $OC_3$  and  $OC_4$  would represent the amount of credit demand from agricultural illusion due to the concessionary rate  $r''$ . The locus of all equilibrium points for the illusion demand curve for agricultural credit when concessionary interest rates are employed at that sector lies along  $DD''$ . This demonstrates how agricultural illusion increases the concessionary transfer.

Delinquency provides another possibility for an income transfer. A "delinquency transfer" may be temporary when farmers do not repay their loans on time, or permanent when they never repay the loan. In the case of the temporary transfer the farmer gains from improved income or reduced costs resulting from control over cash flow. The permanent transfer is equivalent to the real value of the loan principal plus the real value of interest charges less any real amounts repaid on the loan principal and as interest. In terms of Figure 1, the amount of the permanent delinquency transfer would be the  $OC_3$  loan principal plus interest, assuming a concessionary interest rate of  $r'$ , agricultural illusion, and no repayment (equal to the area of  $OracC_3$ ).

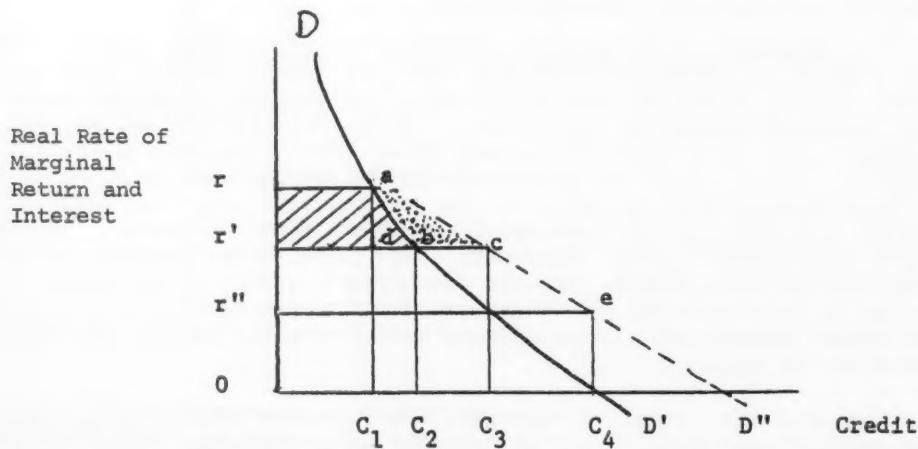


Figure 1. Demand for Credit from Agricultural Lenders.

When inflation is present, a situation common to LDCs, the real rate of interest may be quite low or even negative. The effect is to enlarge the concessionary transfer and the temporary delinquency transfer (because of the lower real value of the loan when repaid). When inflation is anticipated by farmers, the amount borrowed will increase in accordance with the demand schedule and will further enlarge both transfers. The higher the inflation, the greater will be these transfers. In the case of temporary transfers, the longer the delinquency, the greater the transfer.

Clearly the concessionary and delinquency transfers themselves and the additions to these transfers resulting from inflation are to be coveted. Therefore, a government with its control over agricultural credit institutions can use these potential transfers to induce certain types of economic activity and/or to reward certain behavior among borrowers. Moreover, borrowers, in their competition for access to and a share of the transfer, will undoubtedly be willing to bargain with the government. Thus, there is an interplay between government and farmers in which political factors may take on considerable importance.

Heavy delinquency and default rates may be symptomatic of the degree to which political factors have entered into a loan program; when the government does not take legal measures to bring pressure on borrowers to repay, this indicates an unwillingness to bear either the economic or political costs of such action.

The mere existence of these concessionary transfers and the possibility of an easy default transfer create a potential for corruption. Government officials could easily appropriate part of the transfer for themselves by directly or indirectly lending to themselves, or by receiving kick-backs from borrowers.

A concessionary interest rate policy leads to sub-optimal social allocation of credit, of real resources, and of the production of goods. Experience demonstrates that nonprice rationing schemes to offset sub-optimal social allocation are difficult to enforce, and are even more unworkable when political factors intervene. If inflation is present, the additional inflationary transfer enhances the attractiveness of using credit for political objectives and exacerbates the resource allocation consequences.

The concessionary and the delinquency transfers will affect income distribution. Those with access to them will gain at the expense of others. Inflationary conditions will increase the benefits of those who receive these transfers. Concessionary interest rates lead to lower interest revenues for the lending institution if the demand for credit is inelastic and/or the supply of loanable funds is restricted, over the relevant range of the demand schedule. This, in combination with the

well recognized high costs of administering agricultural credit programs, will seriously jeopardize a credit institution's financial viability. Further, political lending will lead to erosion of loan funds due to the extensive delinquency inherent in such loans. The result is that to maintain or increase its loanable funds, the institution must be subsidized by government or obtain foreign loans or assistance.

The role of foreign donors. Foreign economic assistance programs contribute to the use of credit as a political instrument in two ways. First, they have provided considerable economic assistance for agricultural credit programs. Second, they have supported the policy of concessionary interest rates that have the effect of creating concessionary transfers. As a consequence they have been an indirect contributor to the use of credit for political purposes, leading to other transfers. This is particularly true for loans that have been made for general agricultural sector development, where credit typically flows to the larger and more sophisticated farmers and agricultural illusion takes on large dimensions. However, even where foreign aid funds are earmarked for small farmers, the additional funds simply increase the size of the lender's portfolio and might permit some substitution for other funds, releasing them for other, often political, purposes.

Can interest rates be raised and defaulting reduced? The obvious economic solution to prevent all these distortions is to raise interest rates and decrease default. Why, then, have policies of higher rates not been put into effect? Furthermore, why don't many lenders use their legal power to limit default? The suggested answer is that the political cost is too great: governments would lose a means of bargaining for political support; farmers would stand to lose their transfers; and where corruption occurs, officials would lose these sources of income.

#### The Case of Bolivia

The framework is applied to Bolivia during the government of General Hugo Banzer, 1971-1978.

The regional distribution of agricultural credit after 1971 was highly skewed to the tropical lowlands located in the department of Santa Cruz. Between 1973 and 1978, 68 percent of commercial bank loans went to that department. Between 1971 and 1978, 64 percent of the volume but only 23 percent of the number of Bolivian Agricultural Bank (BAB) loans went to Santa Cruz. In contrast, according to the 1976 General Population Census, only 12.6 percent of the rural population lived in that department. Further, for the period 1964-1971, only 43 percent of the BAB credit from regular credit lines had gone to Santa Cruz.

Several interdependent factors explain the highly disproportionate share of agricultural credit going to Santa Cruz in the Banzer period. First, the petroleum and agricultural boom in the region was viewed as the leading edge of the Bolivian economy. Rapid gains in food import substitutes and agricultural exports were expected from its commercial farms, whereas these possibilities were not foreseen for the small-scale traditional farming areas in the highlands. Second, geopolitics was another factor. With the new petroleum development, Bolivia viewed the growth of Santa Cruz as a buffer to further encroachment by Brazil, which had previously taken considerable territory in the rubber boom of 1899.

Whereas both of these factors were important in explaining the disproportionate credit flows, we suggest that domestic political factors were also important in the credit allocation. President Banzer had risen to power in a military coup with the support of a coalition of interest of which a very important element was farmers in Santa Cruz. Hence Banzer was obliged to these persons not only for his sudden rise to power but also for their continued political support.

Institutional and policy structure. Over the 1971-1978 period, 59 percent of bank credit to agriculture in Bolivia came from BAB. In addition, the government-owned State Bank, a commercial bank, loaned approximately another 20 percent. The system was very amenable to government control. Credit was employed as the major agricultural sector policy instrument to "lead" agricultural production by means of a number of special credit programs established by the government and donors of foreign aid. Key features of credit policy were concessionary interest rates and central bank rediscounts to the banking system from special credit lines for agriculture.

Foreign assistance played a major role by providing a steady inflow of funds which freed government funds for lending to some major enterprises such as cotton (little foreign assistance was used for this crop), as well as for liquidity which the institutions needed in view of soaring and heavy delinquency. From 1976 to 1978, there were \$146 million (all figures in the paper are reported in current U.S. dollars) in foreign assistance committed for agricultural credit. A conservative estimate is that at least 45 percent of bank credit (BAB and commercial banks) came from this source.

Concentration of credit. Over the 1971-1978 period BAB loaned \$80.9 million in Santa Cruz in 3,348 loans. Of this amount, \$45.9 million went to cotton in a total of 726 loans. A much smaller amount, \$4.1 million, was directed to 118 farmers for soybeans. The average size loan for cotton and soybeans was \$63,169 and \$34,525 respectively, much larger than the \$5,287 national average. Credit for the two crops, which represented 41 percent of the national BAB loan portfolio, only went to a few

farmers (6 percent of BAB loans). These loans were made primarily to the larger farmers of Santa Cruz, many of whom belonged to that region's elite and/or to powerful regional interest groups such as ADEPA (The Cotton Growers Association).

Income transfers. The recipients of BAB cotton and soybean loans received total income transfers of at least \$44.5 million over the period, an amount only slightly less than the \$49.9 million of principal originally loaned. The average transfers for cotton and soybean loans were \$55 and \$39 thousand respectively per borrower.

Almost \$6.2 million of these transfers result from interest rate concessions of 12 to 15 percent for BAB clients relative to the rates charged by commercial banks for commercial loans. Since the commercial rates are maximum rates established by the Central Bank, they are likely to be less than the true opportunity cost of credit. To the extent this holds true, the concessionary transfer is understated.

The effect of inflation is to reduce the real interest rate and therefore to provide an additional transfer to the borrower. With the exception of 1973 and 1974, inflation in Bolivia was mild, yet the income transfer associated with inflation was very substantial, estimated at \$8.2 million.

From 1971 to 1978, BAB delinquency worsened. At the end of 1971, 15 percent of the loan portfolio was overdue; at the end of 1978 it was 43 percent overdue after reaching a high of 47 percent in 1977. Had many loans not been refinanced or extended, the figures would have been much higher. The delinquency is concentrated in Santa Cruz; in 1978, 68.8 percent of the total BAB delinquency was in that department. Both cotton and soybeans contributed to the high proportion of loan volume delinquency.

At the end of 1978, the delinquency transfer associated with cotton and soybeans was \$30.1 million. Before June 1977, the government would not permit BAB to pressure farmers for repayment; the government issued Supreme Decrees to buy some private banks' delinquent portfolios and transfer them to BAB so that these lenders would not pressure farmers. In June 1977, Banzer issued a Supreme Decree which extended all BAB and State Bank cotton and soybean loans for periods of eight to twelve years. If the loans are paid back as scheduled, the borrowers will pay back virtually nothing in terms of real value due to the depreciating effects of inflation--the equivalent of a permanent income transfer.

The large BAB income transfers for borrowers for the two crops in Santa Cruz cannot be entirely attributed to political factors. Poor client selection, bad weather, insects and marketing are other reasons. But even in cases of the latter, political intervention led to sizeable

transfers. For example, in 1973, BAB and commercial banks financed large quantities of cotton and ADEPA made forward contracts to sell cotton on the world market. When the world price exceeded the forward price, ADEPA refused to sell. The government supported them as Banzer established a minimum price by Supreme Decree. The world buyers refused to pay this higher-than-contracted price and much cotton remained unsold while delinquency soared.

The case of BAB is suggestive of what also happened in the State Bank. Unfortunately, inadequate data do not permit a breakdown of transfers for credit from that institution. They are, however, sizeable. This institution also began to lend heavily for cotton and soybeans in Santa Cruz after 1972. By 1977, they had discontinued lending to agriculture because of heavy delinquency. In 1978, they had \$22.4 million in 232 past due loans, most of which were for cotton and soybeans. Clearly, income transfers associated with these loans were also very substantial.

Consequences. The effect of credit being used as a political instrument to benefit the Santa Cruz commercial farming elite undoubtedly contributed to political stability during the Banzer reign. However, the elite's access to credit and the associated income transfers gave them a larger share of national income. Their ability to practice agricultural illusion through investment in real estate, commerce and conspicuous consumption further enhanced their income and worsened regional and personal income distribution. For example, the highland peasants gained little, and if it had not been for foreign aid for small farmer credit which began in 1975, it is doubtful that this large mass of farmers would have received much credit at all. It is very plausible that such inequities were important factors in the defeat of the government's candidate in the 1978 elections.

The long-run viability of financial institutions was seriously harmed. After 1976, the State Bank withdrew from agricultural lending because of the high costs associated with its heavy delinquency. In March 1979, BAB had to be rescued from bankruptcy. A \$41.5 million government bond issue permitted BAB to meet its financial obligations.

#### Implications

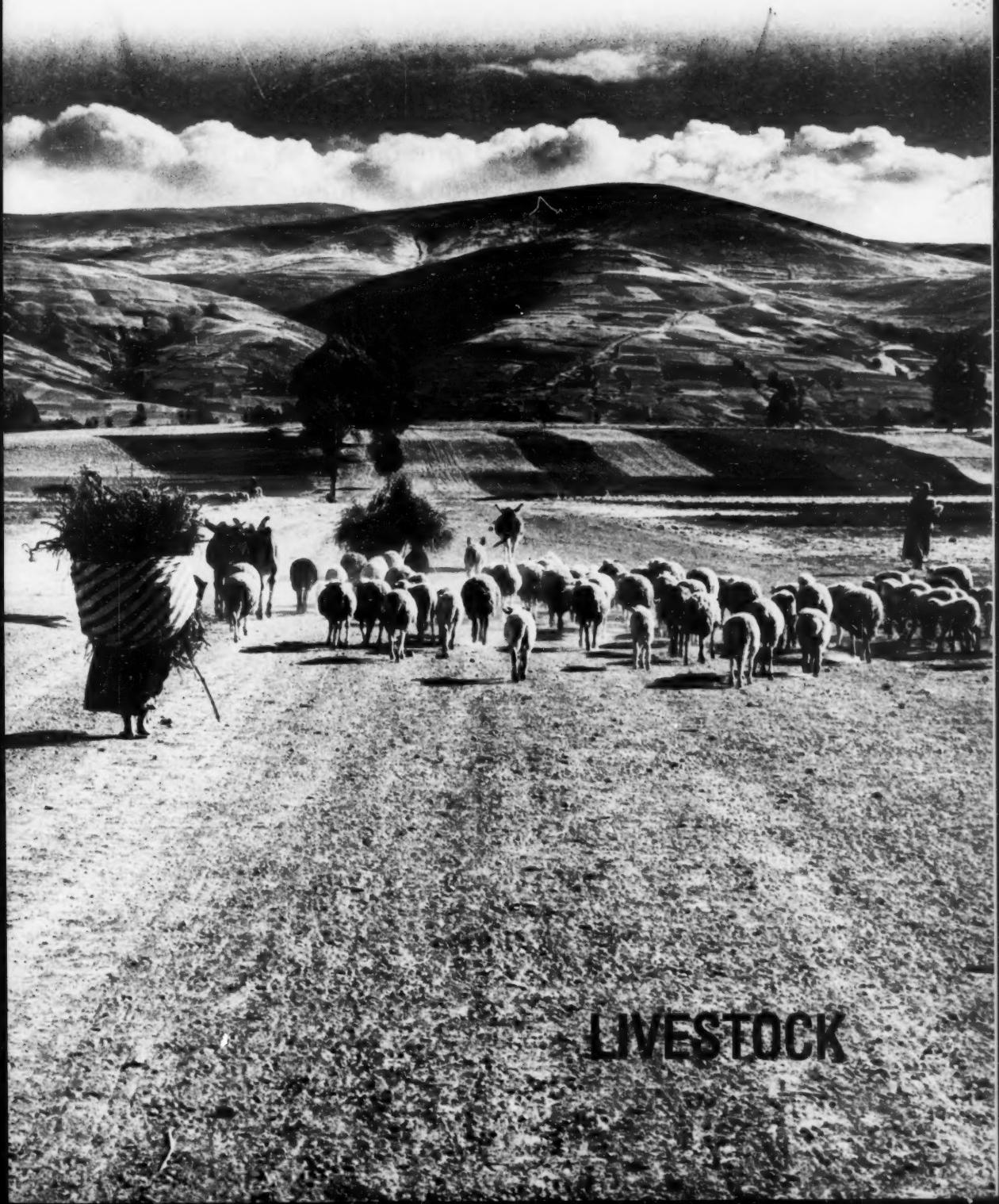
What lessons does the Bolivian experience provide for the design, or redesign, of credit programs in LDCs? Some ways to reduce political elements in agricultural credit would be to reduce inflation, eliminate the concessionary interest rate policy, and decrease default. The elimination of government agricultural credit institutions would be a stronger move; but that would be going too far, given the historical evidence of commercial banks shunning agricultural loans, especially to small farmers. The elimination of concessionary interest rates would

put the cost of agricultural credit on a par with the opportunity cost of money in other uses, so that attractiveness of farm credit as a patronage measure would be diminished. Moreover, by raising the price of credit, it would flow to its more productive employments, and higher interest might stimulate increased savings.

However, there would be considerable difficulty in raising interest rates. The borrowers are accustomed to receiving the concessionary transfer and would resist losing this benefit. For the large farmer, it would mean reducing the opportunity to get cheap money for other uses; for the small farmer, it would be a loss of the preferential treatment he believes is owed to him; from both farmer classes the government would expect resistance. Furthermore, it is doubtful that the government would be inclined to raise the rate, because that would seriously reduce its options in using agricultural credit as political patronage.

The Bolivian case is not unique. It is likely that political forces figure strongly in credit allocation decisions in most nations. While patronage in distribution may contribute to short-run political stability, it is subject to abuse and has undesirable consequences for resource allocation, income distribution and financial institution viability. The degree to which credit can be used as a political instrument would be substantially reduced if concessionary interest rates were eliminated, a tougher stance on default were taken, and inflation were reduced.

[Edited extract from the American  
Journal of Agricultural Economics,  
Vol. 63, No. 1, February 1981, pp. 66-72.  
Copyright© The American Agricultural  
Economics Association.]



LIVESTOCK

LIVESTOCK ON THE HIGH PLATEAU  
OF THE ANDES IN PERU  
(PHOTO: INTERNATIONAL LABOR OFFICE)

## Potential of Sheep and Goats in Less Developed Countries

C. Devendra

[This paper addresses the current status of sheep and goats in the less developed countries: the value of these animals; their contribution in terms of meat, milk, fiber and skins; their socioeconomic and nutritional status; present levels of production; and their special characteristics in the potential for increasing food production. Particular emphasis is placed on the present constraints on production and on the research thrust necessary to stimulate research and development on both species.]

The maximization of world food supplies, essentially of calories and proteins, assumes a thorough exploitation of all available avenues of food production. Animal proteins are in demand, and increased production is justified by the tendency toward crop cultivation that provides starch-rich, protein-poor diets for the people in the less developed countries (LDCs), especially for low income groups. Animals can forage on land that will not produce crops.

In animal production systems, a particular species may be utilized because of its economic importance, its place in agriculture, or its ability to make use of available feedstuffs. Sheep and goats are the most neglected of farm animals with value for humans in LDCs. While the functional value of these small ruminants as renewable resources for poor people in LDCs is widely recognized, efforts to increase the productivity from them have been meager. The development of technology is hampered by a sparse base of knowledge due to limited research, and a variety of constraints. Limited knowledge about sheep and goats is associated with inadequate understanding of their production systems and incomplete exploitation of

Mr. Devendra is with the Malaysian Agricultural Research and Development Institute, Serdang, Selangor, Malaysia.

the species. Increasing sheep and goat production in LDCs, therefore, offers important opportunities for improving the living conditions of the people in these countries.

Most LDCs are located in the tropics and subtropics. The per capita incomes in these countries are low. Usually, the intake of energy and especially proteins is also low, and FAO data (1976) indicate that countries in Africa and South Asia had the lowest animal protein intakes averaging 11.4 and 9.8 g per capita, respectively.

#### Population of Sheep and Goats

It is significant that the LDCs possess approximately 400 million sheep and 327 million goats, about 40% and 80% of the world totals (see Table 1). The largest proportions of the total world sheep and goat populations, 15.4 and 30.7% respectively, are found in Africa.

TABLE 1. DISTRIBUTION OF SHEEP AND GOATS IN THE LDC BY REGION<sup>a</sup>

	Total sheep population (thousands)	Distribution <sup>b</sup> of sheep, (% of world)	Total goat population (thousands)	Distribution <sup>b</sup> of goats, (% of world)
Africa	159,496	15.4	126,704	30.7
Central America	6,565	.6	13,573	3.3
South America	84,842	8.2	27,145	6.6
Near East	81,045	7.8	47,211	11.5
South Asia	67,928	6.5	112,759	27.3
Total in LDCs	399,876	38.5	327,392	79.3

<sup>a</sup>Source: FAO Production Yearbook, 1976.

<sup>b</sup>The total world population of sheep was 1,033.6 million and of goats 403.2 million.

Within each major region, both sheep and goats are widely distributed. Goats are probably more widely distributed than sheep, ranging all the way from the arid and semi-arid areas to the super-humid environments. In India, for instance, goats range from the high altitudes and arid areas of the north to very humid coastal areas of the south. Sheep tend to be more concentrated in the arid regions of the north Indian plains, but goats also flourish and prefer areas of low rainfall - 75 cm or less. Sheep are more important than goats in the highland eco-

zones and in the semi-arid areas of North Africa, the Near East and Northwest Africa. By contrast, goats are more important in the Indian subcontinent, and a similar situation exists in Nigeria, Haiti, the Dominican Republic, Venezuela, Malaysia and Indonesia. In parts of North Africa, the Sahel and East Africa, on the other hand, sheep and goats are about equally important.

An analysis of population changes between 1961-1965 and 1976 indicates that the increase for goats (14%) in all LDCs was about twice that for sheep (7%); the annual rate of growth for sheep was about 0.5% and that for goats was about 1%.

#### Functional Importance of Sheep and Goats

Sheep and goats are valued primarily for the production of meat, milk and fiber (wool, hair, mohair and pashmina). In addition, they are valuable for the production of blood (for serum), fertilizer (blood, bone, dung) and horns. They also have value for transport, sport, prestige, employment and rural nutrition and as experimental animals.

According to the United Nations 1976 Statistical Yearbook, as many as 10 million full-time, economically active people were dependent on sheep and goats in LDCs, notably in the Near East, Africa and South Asia. These people represented about 3.5, 1.1 and .7% respectively, of the total labor force in the three regions. Gross domestic product (GDP) data suggested that Africa ranked first in value of total production from these animals, followed by the Near East. In the proportional contribution of sheep and goats to national income the near East was highest, followed by Africa, Latin America and South Asia. There is, however, considerable variation among countries in these regions.

Meat Production. Table 2 presents the contribution of sheep and goats to meat production according to the 1976 FAO Production Yearbook. Sheep and goats in LDCs contributed about 46 and 72%, respectively, of the total world production of mutton and lamb and goat meat. South Asia produced both the highest percentage of mutton and lamb (20%) and the highest percentage of goat meat (26%). Much of the mutton produced came from Afghanistan and Pakistan, while India contributed most of the total goat meat produced in the region.

The demand for goat meat is high throughout the LDCs, and inadequate supplies to meet the demand result in relatively high prices per unit of meat sold on the market. This situation is particularly evident in several countries in South Asia and the West Indies. With goat meat supplies insufficient to meet the demand, mutton has been sub-

TABLE 2. CONTRIBUTION OF SHEEP AND GOATS TO MEAT PRODUCTION<sup>a</sup>

Region	Total meat production from ruminants <sup>b</sup> m tons, 10 <sup>3</sup>	Mutton and lamb, m tons, 10 <sup>3</sup>	Avg carcass yield per sheep, kg	Goat meat, m tons, 10 <sup>3</sup>	Avg carcass yield per goat, kg	Mutton and lamb as % of total world production <sup>d</sup>	Goat meat as % of total world production <sup>e</sup>
Africa	18,783	672	14.0	424	10.0	12.2	25.7
Central America	3,373	20	15.4	20	12.3	.4	1.2
South America	4,051	150	14.6	55	12.3	2.7	3.3
Near East	1,308	605	16.4	257	14.3	10.9	15.6
South Asia	2,429	1,099	13.9	432	12.0	19.9	26.3
World	52,889	5,530	15.0	1,644	12.0	-	-

<sup>a</sup>FAO (1976)<sup>b</sup>Beef and veal + mutton and lamb + goat meat.<sup>c</sup>Excludes offals and slaughter fats.<sup>d</sup>Contribution from LDC as percentage of total world mutton and lamb production = 46.0%.<sup>e</sup>Contribution from LDC as percentage of total world goat meat production = 72.3%.

stituted in some countries where there is a tradition of goat meat consumption. Goat meat is used mainly for home consumption in village and rural areas.

Milk production. Production of goat milk is more important than production of sheep milk in LDCs (Table 3). According to the 1976 FAO Production Yearbook, LDC goats produced about 69% of the world supply of goat milk, while sheep in the LDCs produced 47% of the world's sheep milk. The bulk of the LDC sheep milk was produced in the Near East, notably in Iran and Syria. No sheep milk was produced in Central and South America. Goat's milk was produced in all the regions, with South Asia most important, followed by the Near East and Africa.

TABLE 3. CONTRIBUTION OF SHEEP AND GOATS TO MILK PRODUCTION<sup>a</sup>

Region	Total milk production <sup>b</sup> (1,000 tonnes)	Sheep milk, <sup>c</sup> (1,000 tonnes)	Goat milk, <sup>d</sup> (1,000 tonnes)	Sheep milk as % of total world production	Goat milk as % of total world production
Africa	12,371	532	1,230	7.4	17.6
Central America	6,823	--	246	--	3.5
South America	18,789	--	132	--	1.9
Near East	9,696	2,453	1,286	32.7	18.4
South Asia	15,684	535	1,904	7.1	27.3
World	432,672	7,503	6,975	--	--

<sup>a</sup>FAO (1976).

<sup>b</sup>From cows + buffalo + sheep + goats.

<sup>c</sup>Contribution from LDC as percentage of total world production = 46.9%.

<sup>d</sup>Contribution from LDC as percentage of total world production = 69.8%.

Fiber, skins and hides. South America and the Near East were leaders in greasy wool production. Peru produced most of the greasy wool in South America, and in the Near East Turkey, Iran, Iraq and Syria were important.

Goats in the LDCs contributed importantly to the world supply of skins and hides. Goat skins were produced mainly in South Asia and

the Near East, which together accounted for about 72% of total world production. India, Bangladesh, Indonesia and Nepal, and in the Near East Turkey, Iraq, Saudi Arabia, Yemen, Iran and Syria are the leading producers. The bulk of LDC sheep skins was produced in Africa and the Near East--23% of world production. In Africa, the main contributing countries were Sudan, Morocco and Ethiopia; and in the Near East Turkey, Iraq and Iran.

Miscellaneous functions. Apart from their main functions in the production of meat, milk, fiber and skins, sheep and goats are also important in a number of other ways. They are used as investments, as insurance against the failure of crops, for slaughter during festive occasions, for recreation, as a supply of manure for fertilizer and as experimental animals. Both species have also been used occasionally for transportation, especially in mountainous regions such as Nepal, Bhutan and Sikkim. In addition, sheep and goats also supply horns, hooves, blood for serum, blood and bone meal, all of which have commercial value.

Impact on rural health and nutrition. Sheep and goats have a significant impact on rural health and the nutrition of several million people, especially those on the poverty line in the LDC rural areas where they are raised. Particularly for the more vulnerable groups--pregnant and nursing mothers and the young--goats and sheep provide a small but consistent and significant supply of animal proteins of high biological value in the form of meat and milk, plus essential minerals and fat-borne vitamins. These ready sources of meat and milk often make the difference between adequate nutrition and malnutrition for many rural people who cannot afford to buy such products and are unable to produce these products by rearing cattle or buffaloes. The magnitude of this contribution is not easily measured, but it is probably more significant than is realized. The fact remains, however, that throughout LDCs as a whole the average intake of meat and milk from sheep and goats is negligible, and its possibility for increase is, therefore, potentially significant.

#### Pattern of Ownership

Attempts to increase research and development efforts on goats and sheep will need to take into account the pattern of ownership of these species in LDCs. Such efforts must address themselves to the small-holders or landless agricultural laborers, who represent most of the world's poor, because in many parts of the world the great majority of sheep and goats are owned by poor farmers or herdsmen. Elsewhere large holdings prevail.

According to World Census of Agriculture, 60 and 71% of the sheep and goats in Asia were found on land holdings consisting of less than

5 hectares (Table 4), reflecting also the pressure on the use of land for alternative purposes. In Africa, however, where land is less limiting, 85 and 92% of the goats and sheep, respectively, were found on land holdings of more than 100 hectares. And in South America most of the sheep are found on large-scale ranches with large herds.

TABLE 4.

DISTRIBUTION OF LIVESTOCK BY SIZE OF FARM FOR SOME LDC REGIONS<sup>ab</sup>

Region	No. of countries	Animal population	1 to 5 ha, %	5 to 10 ha, %	10 to 20 ha, %	20 to 100 ha, %	>100 ha, %
<b>Sheep</b>							
Africa	4	45,148,928	4.4	.7	.8	2.1	91.7
Asia	3	31,518,507	60.0	16.0	13.8	8.7	1.3
South America	5	39,534,545	25.0	4.6	7.0	7.0	59.0
<b>Goats</b>							
Africa	3	7,823,319	7.6	1.0	.6	5.3	85.2
Asia	6	29,020,627	71.2	14.3	8.6	5.0	.6
South America	4	6,521,938	64.3	9.3	10.0	10.2	5.9

<sup>a</sup>FAO - Report of the 1960 World Census of Agriculture (1971).

<sup>b</sup>In Africa, most of the large "farms" would be communal rather than individually owned.

In many parts of the world, small herds owned by small farmers are the dominant pattern. In the West Indies, ownership of small flocks of sheep is the rule rather than the exception. In Indonesia, it is common for small flocks of two to 10 head to be owned by peasants. In Fiji, goat raising is entirely in the hands of the Indian settlers, on farms, and the average number of goats carried is three per hectare. Small flocks (one to nine) are also common in Malaysia. In Himachal Pradesh in India, the size of both migratory and stationary flocks of sheep ranged from 11 to 54 and 5 to 51.7, respectively. In Nigeria and the Ivory Coast, the average numbers of goats and sheep per flock, respectively, are 2-3 and 4-5.

Systems of Production

There are four systems of sheep and goat production in the tropics and subtropics: (1) tethering, (2) extensive production, (3) intensive production and (4) integration with cropping systems.

Both tethering and the extensive systems represent traditional village systems typical in Africa, parts of Central America and South Asia. Here, the animals browse and scavenge on what feeds are immedi-

ately available near the farm and the house. If animals are tethered, they will be tied so they cannot move very far; with an extensive system, they will be allowed to forage more widely. A tendency to treat sheep and goats with special care and also to feed them with kitchen remnants in Africa, however, encourages the animals to remain closer to the villages than they otherwise would.

Tethering and extensive production are by far the most common systems. A very low level of mostly unpaid family labor represents the main work input. In the extensive system, sheep and goats may graze over large areas, especially on marginal lands with low rainfall which are unsuited for alternative forms of agriculture. This is more evident in Africa than in Asia (Table 4). The system includes nomadic, transhumant (seasonal migration of livestock) and sedentarized patterns of production, and is characterized by the fact that more animals tend to be carried than in the intensive system. Also, few or no feed concentrates, salt or mineral licks are provided.

The intensive system is one in which the animals are fed in confinement with limited access to land, a system with a high labor and cash input. In this system, cultivated grasses and (or) by-products are fed *in situ*. In Jamaica, intensive goat production on Pangola grass with a carrying capacity of 37 to 45 goats per hectare has been demonstrated. An avenue that merits exploitation on an intensive basis is the feeding of agro-industrial by-products such as rice straw with molasses-urea supplementation, since rice straw is abundantly available in monsoon Asia, with yields of about 1.4 tons/hectare. With goats, this system of feeding also has the advantage of allowing control over the animals. Dairy goats are usually stall-fed; in Israel, for example, intensive milk production mainly from Saanen goats is based on this system.

A variation of intensive production based on a stall feeding approach is feedlot fattening. This method appears to have had little application with goats, but it has been used successfully with sheep, in Egypt, for example. These studies suggest that much more use can be made of such systems, especially in environments where agro-industrial by-products are plentiful.

The fourth method, the integration of sheep and goats with crop agriculture, has been practiced to some degree in most countries, but the nature and extent of the integration depend on the type of crops being grown and the relative importance of sheep and goats. For example, in Fiji, 70% of the goat population is found in the sugar cane growing areas. In Sri Lanka, Malaysia, Indonesia and the Philippines, sheep and goats undergraze coconut, oil palm or rubber plantations. The advantages of the system are: increased fertility of the land via the return of dung and urine, control of waste herbage growth, reduced

fertilizer wastage, easier management of the crop and possibilities of increases in crop yields and greater economic returns.

The feed cost in each of the production systems is different, and represents an important determinant of the ultimate net economic benefit. In Malaysia, for example, the proportion of total costs attributable to feed for goats grazing uncultivated grass for meat was 2.2%. For goats stall-fed with cultivated grass for meat, feed represented 23% of the total cost. For goats stall-fed on cultivated grass and concentrates for milk, the figure was 48.2%.

#### Level of Productivity

The present level of productivity of both goats and sheep is generally low, due to a combination of factors including under-feeding, disease and poor husbandry. In Ghana, for example, the birth rate (young born as a percentage of females mated) of a flock of sheep and goats was only 69.4%, among which the annual mortality rate was 20.0%; a parallel situation in other regions of LDCs is not uncommon. Goat size and numbers are determined largely, especially in the extensive and free range system, by fluctuations in the environment, notably the availability of feed.

Low productivity will persist in the extensive regions, such as parts of Africa and the Middle East, until improvements are made in husbandry, management, organized breeding and disease control. There is no doubt that improved husbandry practice is the most effective means of ensuring high productivity from both goats and sheep; without sound husbandry practices, the potential productive capacity of these animals is often not realized.

Of the various environmental factors which limit production from sheep and goats, nutrition is by far the most important. The live weight at slaughter, hot carcass weight, and the weight of meat can be improved by as much as 53.8, 79.3 and 47.1% respectively, as shown in a Malaysian comparison of rural goats with those of the same breed in experiment stations. Equally significant is the fact that the total salable weight, and therefore returns, can be improved by 34.1%. Every effort must therefore be made to ensure that animals are well fed, quantitatively and qualitatively, through application of current concepts of applied nutrition.

#### Effective Use of Genetic Resources

The low level of production from sheep and goats is also due to poor quality of the genetic resources. Because of neglect, inadequate knowledge of the value and productive capacity of indigenous breeds, and very little purposeful selection and breeding, the performance of

both species has been generally poor. However, there are examples of outstanding breeds, e.g., the Chios sheep of Greece and Cyprus, the Barbados Blackbelly sheep of the Caribbean, the Maradi goats of Niger and the Barbari and Black Bengal goats of India.

In view of the importance and possibilities of increasing productivity by genetic upgrading that have been observed when this practice was undertaken, the improved goat breeds that are likely to make the greatest contribution within the tropics and subtropic regions are listed in Table 5.

TABLE 5. SUGGESTED IMPROVER BREEDS OF GOATS<sup>a</sup>

Speciality	Breed	Climate in country of origin
Milk: high yields	Saanen <sup>b</sup> Anglo-Nubian <sup>b</sup>	Temperate, subtropical, wet Temperate, tropical, dry
Milk: medium yields	Jamnapari Barbari Beetal Maltese	Tropical; subtropical dry Tropical, dry Tropical, dry Subtropical, dry
Meat	Barbari Jamnapari Ma T'ou Kambing Katjang	Tropical, dry Tropical, subtropical, dry Subtropical, humid Tropical, humid
Prolificacy	Fijian Black Bengal Barbari Malabar <sup>b</sup>	Tropical, humid Tropical, dry Tropical, dry Tropical, humid
Mohair	Ma T'ou	Subtropical, humid
Skin	Angora Black Bengal Red Sokoto	Subtropical, humid Tropical, dry Tropical, humid

<sup>a</sup>Devendra (1974).

<sup>b</sup>Indicates breed is polled.

#### Overgrazing

In increasing the use of chosen breeds in well-planned programs for meat, milk, fiber or skin production, one must have control over numbers and match these with land and feed resources. With goats, inadequate control in the past is perhaps the main reason for environmental degradation. It is estimated, for example, that the rangelands of northern Iraq can carry about 250,000 sheep and goats without degradation; currently, however, the population is more than four or five times that large. Similarly, in Rajasthan in India, the area available for grazing dropped from 13 million to 11 million hectares between 1951 and 1961, while the total population of goats, sheep and

cattle increased from 9.4 to 14.4 million and is still growing. The practical consequences of this situation are the extension of cropping to marginal land and a reduction in the total grazing area.

#### Measures of Efficiency

Efficiency of energy and protein conversion. The approximate efficiencies with which goats convert various animal feeds to food for humans are indicated in Table 6. It is emphasized that these efficiencies are approximate values that vary with the rate of production. The efficiencies of milk production in goats are higher than the values of 21, 23 and 10% for energy, protein and energy cost of protein, respectively, reported by Holmes for dairy cattle. The efficiency values for energy conversion in goat meat production are generally similar to values of 5.2 to 7.8% reported by Taylor for beef, and slightly higher than values of 2.4 to 4.2% reported by Spedding and Hoxey. The apparently greater efficiency of goats than of cattle in converting nutrients to milk is an important characteristic of the species.

Biological efficiency. The biological efficiency of an animal is defined as a measure of the ability of the species to reproduce, survive and maintain its numbers in a given environment. With respect to goats, this definition is particularly relevant in light of the species' characteristics: short generation interval, reproductive capacity and the efficiency with which they produce valuable animal products.

Present evidence suggests that goats are more efficient than other species. This apparently high efficiency of goats may not be generalized; it may be specific to certain conditions, or to certain feeds--especially if these are coarse. But it is distinctly possible that goats derive a higher metabolizable energy from their feed than do other species.

TABLE 6. APPROXIMATE EFFICIENCIES OF ENERGY AND PROTEIN  
CONVERSION IN GOATS<sup>a</sup>

Goats	% efficiency		Energy cost of protein, g/Mcal MED
	Energy <sup>b</sup>	Protein <sup>c</sup>	
Milk production (lactation)	24.0	23.7	14.5
Meat production (fattening)			
On grass	4.7	9.1	5.1
On grass + concentrates	6.7	10.2	7.5

<sup>a</sup>Devendra (1976a).

<sup>b</sup>Energy expressed as kilocalories/100 kcal of metabolizable feed energy consumed.

<sup>c</sup>Proteins are expressed as edible protein per 100 g of feed protein consumed.

<sup>d</sup>Edible protein per megacalories ME.

### Disease Status

Disease is one of the main constraints on sheep and goat production in the LDCs. Economic loss due to disease and parasites is probably high, and in sparsely populated areas where the veterinary and diagnostic services are weak, the losses must be considerable. It is perhaps worth stressing that in adults the most severe effects of disease and parasites are manifested in production losses, including problems of fertility. These effects are due to nutritional stress, debilitation and internal parasites. In Nigeria, gastrointestinal helminthiasis (caused by parasitic infestation) is reported to be the most serious disease problem among Udaah and Yankasa sheep. It is patently clear that much production loss can be reduced by improved husbandry management. Vigorous research on animal diseases therefore represents another potential means of increasing productivity from both species.

### Exploiting the Characteristics of Sheep and Goats

A prerequisite to maximum exploitation of any species in an understanding of those characteristics that are peculiar to the species.

Small size. The small size of sheep and goats as compared to other meat and milk producing animals is significant for a number of reasons:

- (1) *Economic:* Low individual sizes mean lower cost and also small initial investment and correspondingly small risk of loss from individual deaths.
- (2) *Managerial:* Both species are conveniently cared for by unpaid family labor (women and children), occupy little housing space, and supply both meat and milk in quantities suitable for immediate family consumption. These facts have the important advantage of minimizing the problems of storage.
- (3) *Biological:* With minimum land and a low level of nutrition, sheep and particularly goats are more likely to survive than are cattle or buffalo.

Digestive efficiency. Small ruminants have the unique capacity to convert waste vegetation and roughages effectively, especially in the marginal areas, to products that are of value to man.

Reproductive efficiency. The factors that will influence reproductive efficiency are age at first mating, life span of the breeding flock, mortality rate, and lambing or kidding percentage. Goats are superior to sheep in reproductive performance. In Nigeria, for example, comparative

reproductive rates are 115% lambing percentage and 150% kidding percentage a year. Similarly, in Sudan, high offtakes in goats compared to sheep are associated with a high birth rate and a high level of survival after the first week of life. Twinning appears to be more common in goats than in sheep. Often, high fertility is coupled with a relatively short generation interval, both of which are important factors in early economic viability of sheep and goat projects.

### The Future

The demand for more food from sheep and goats, consistent with their functional importance, implies that if present trends continue the populations of both species are likely to increase. Can the available resources support this growth? Table 7 provides estimates of the demand for sheep and goats in the year 2000 based on the United Nations medium projected population and increased per capita consumption of sheep and goat meat associated with increased disposable income.

TABLE 7. PROJECTED HUMAN, SHEEP AND  
GOAT WORLD POPULATIONS<sup>a,b,c</sup>  
(in millions)

Category	1976	2000 <sup>b</sup>	% increase
Human	4,043	6,321	56.3
Sheep	1,038	1,853	78.5
Goats	413	900	117.9

<sup>a</sup>UN population projections, medium variant.

<sup>b</sup>FAO (1976).

<sup>c</sup>Projections for 2000 assume no changes in the present level of productivity and pattern of consumption.

Assuming that the 1976 carcass yield data and current production and consumption patterns (Table 2) do not change, it is estimated that the sheep and goat populations in the year 2000 will be 1,853 and 900 million, respectively. These totals represent increases of about 79 and 118% over the 1976 populations. The increases are enormous, and it is doubtful that they can be supported, especially in relation to the growing human population, given the competition for land and other resources. Increased production per animal unit is thus very important. T. C. Byerly contends that in order to maintain or increase per capita supplies of ruminant meat and milk, the world as a whole will have to increase support for research and development by at least 45% over the next 25 years.

### Priorities for Research

In examining productive potential in the context of priorities for research, it is essential to consider three important facets of the program: (1) production system, (2) target ecological zones, and (3) major contributing disciplines. Consideration of these factors allows one to assess the nature of the problem and the different disciplines that are likely to stimulate increased production in any one target area. An attempt is made below to identify types of production systems with major contributing disciplines in appropriate target zones in the regions embracing LDCs (Table 8).

TABLE 8. TYPE OF PRODUCTION SYSTEM, TARGET ECOLOGICAL ZONES AND MAJOR CONTRIBUTING DISCIPLINES INVOLVED IN EFFECTING THE PRODUCTIVE POTENTIAL OF SHEEP AND GOATS IN THE LDC

Type of production system	Target ecological zone	Region	Major contributing disciplines
Tethering	Humid, subhumid and semi-arid	Southeast Asia, East and West Africa, Near East, Central America	Animal health Nutritional management Socio-cultural Systems analysis Marketing
Extensive	Arid and semi-arid	North and North-east Africa, Central America, Near East	Breeding and genetics Marketing Nutritional management Range management Socio-cultural
Intensive	Humid and subhumid, semi-arid	Southeast Asia, West Africa, Central America, Near East	Animal health Breeding management Marketing Nutritional management Systems analysis
Integration with cropping systems	Arid, and subhumid and humid	Southeast Asia, East and West Africa, Near East	Animal health Breeding management Marketing Nutritional management Systems analysis

The analysis is broad and is intended only to emphasize the scope for research. Disciplines are not given any order of importance, and the list may not be complete. Nevertheless it does serve to point out the significance and importance of each discipline in ensuring potential production from sheep and goats in LDCs. Effective application of these disciplines is likely to increase substantially the current low level of productivity of both species. While each discipline could have a significant impact on production, multidisciplinary involvement is essential.

to ensure an efficient use of existing resources compatible with maximum returns. In addition to the technical disciplines included in the Table, administrators should note that there has been too little development of delivery systems for services and technology to farmers, land tenure systems, and of marketing incentives to increase offtakes from both indigenous and superior genotypes.

The relatively low contribution of sheep and goats and their general neglect in LDCs in the past can be attributed to a combination of factors: low priority, poor infrastructure, limited financial support and inadequate planning to stimulate production. Associated with these limitations is the fact that technical assistance from developed countries and international agencies, including FAO, has been directed mainly at other classes of livestock. The task ahead therefore is to correct past tendencies and to promote maximum food production from sheep and goats. Essentially, this means effective use of the limited resources, and equating the importance of productivity to the nutritional adequacy of the ecosystem. Since the greatest potential for increased productivity from sheep and goats is in LDCs, the research programs with the greatest impact will be those that are implemented in LDCs *in situ* and which can obtain collaborative support from the developing countries with a demonstrable capacity.

#### Concluding Comments

The development of sheep and particularly goats in LDCs, both neglected resources, represents a new initiative. The initiative is timely because increasing the productivity of these animals represents a hope for improving the living standards of the undernourished poor people in these countries. Enlightened interest and a joint strategy for development should involve both developed and underdeveloped nations. Direct action is necessary to alleviate current problems of productivity, and to increase the efficiency with which existing resources are used to combat poverty. This challenging task promises real benefits in the future in terms of improved health, wealth and productive capacity of the developing countries as a whole.

[Edited Extract from Journal of Animal Science, Vol. 51, No. 2, 1981, pp. 461-472. Copyright© the American Society for Animal Science, Champaign, Illinois.]

## Not all Endangered Species are Wild

Charles Hickman

[Many domestic livestock breeds in developing areas are well adapted for survival in their particular environments, and could serve as the basis for breeding programs to raise the productivity levels of the stock. But this is not being done; and some of the breeds are just disappearing due to indiscriminate crossbreeding.]

More than 30 years ago, one of the founders of modern animal breeding practice, Dr. J. L. Lush, undertook to explain in a report to the UN Economic and Social Council (ECOSOC) some of the principal means of improving the heredity of farm animals. Some of the language used was a bit technical: "Progress per generation as a consequence of mass selection is expected to be the selection differential times the hereditability of the characteristics for which the selection is practised." But some of the conclusions were simple and straightforward: "The possibilities are complex enough that preserving and improving rare breeds should be encouraged." Whatever may have been the impact of Lush's report to ECOSOC, indigenous breeds of livestock in developing countries have remained largely ignored, or, if considered at all, have been judged by standards of performance established in industrialized countries.

Developing countries contain the predominant share of the world's livestock populations with about two thirds of the cattle, 60 percent of the pigs, more than half the sheep and nearly 95 percent of the goats. But output of meat and milk is another matter. About two thirds of total beef production and well over 60 percent of pigmeat production is accounted for by industrialized countries. Annual

Charles Hickman has been serving as an animal officer with FAO, the Food and Agriculture Organization of the United Nations, based in Rome, Italy

output from dairy cows in industrialized countries is more than four times higher per animal than in developing countries.

But such figures represent only one side of the story. Whatever their level of production, livestock in the developing world provides better nutrition, family income and employment opportunities to millions of families and villages, along with draft power and a more balanced form of agriculture. Moreover, they have demonstrated superior genetic ability to withstand harsh environments, including heat, humidity, tropical diseases and other challenges to survival at high altitudes or in marginal agricultural regions where the higher producing livestock of the temperate zones have found it difficult or impossible to survive. Yet it is only the livestock in the prosperous countries that have received the benefits of genetic improvement programs, and as a result possess genetic superiority in levels of production. It has proved difficult to develop breeds that combine genetic adaptation with genetic level of performance. This is a field meriting much more study if poor countries are to derive greater benefits from their livestock populations.

What is badly needed in developing countries is the institution of management programs which would direct and control selective breeding of indigenous livestock varieties in order to improve the breeds. This would include both raising productivity levels and selecting for maximum survival qualities, as well as keeping systematic records on the animals and their ancestries.

#### Perils in Crossbreeding

Experience and research thus far have provided two critical results. First, livestock breeds developed in temperate zones do not survive in radically different environments, such as the humid tropics. Secondly, crossbred offspring from low-producing native stock sired by high-producing non-adapted stock excel in level of performance in harsh environments.

The consequence of these two facts are as obvious as they are disastrous to the preservation of native stock. The urgency for achieving higher production levels encourages widespread crossbreeding, uncontrolled loss of native breeds, and the consequent loss of genetic ability to withstand severe environmental stress.

The dilemma arises from the fact that crossbreeds cannot reproduce in their offspring the hybrid vigor that they themselves exhibit. The superior performance is lost because it is dependent upon the matching of unlike genes from the two parental breeds. The highest benefit from this matching, known as heterosis, is obtained from the greatest genetic distance between parental breeds, in other words, in the first cross.

Any attempt to mate between first crosses, known as F<sub>1</sub>s, results in reduced hybrid vigor and extreme genetic variability.

Before the process of genetic adaptation to different environments was clearly understood, many attempts were made to introduce exotic breeds from the temperate zones into the humid tropics. Most such projects ended in dismal failure because the imported animals died shortly after arrival in the harsh foreign environment, or their reproductive rate declined to the point that there was no replacement stock. This has applied especially to dairy cattle, but experience with exotic breeds of sheep and goats has been much the same. Among beef cattle there have been some useful introductions, particularly of new breeds formed from crossbred foundations. However, in well-controlled experiments, many native breeds have shown they could compete with, or even surpass the imported breeds in levels of beef production.

Unfortunately, most comparisons of performance made between indigenous and introduced breeds have been based on the methods and standards of industrialized countries. High individual performance and high feed input are principal criteria. Similarly, the potential for genetic improvement in indigenous breeds is often circumscribed by Western standards. There has been a tendency to avoid attempts at genetic improvement of indigenous breeds because of the lack of production data. Without such data, according to Western methods, a minimum population of 50,000 animals and a period of 30 years would be required to achieve an improved stock. Obviously, this would be a very stiff requirement for many native breeds, some of which simply could not muster that number of breeding females.

Improvement of indigenous breeds is further hampered by the fact that the more progressive farmers who are essential to the development of constructive breeding programs are often likely to be the very same ones who will be contacted by salesmen marketing semen from the industrialized world. This is not to argue that the use of artificial insemination based on imported semen should always be avoided in Third World livestock development programs. In many cases, it offers the only hope to an otherwise unprofitable livestock industry. The danger is that the decision may be made to import semen whether it is the best approach or not because there is a lack of data comparing improved indigenous breeds to crossbreds from exotic stock. There is evident need for a cooperative effort on the part of all international organizations involved in artificial insemination work to assemble sufficient data on which to base breed recommendations for local communities.

As might be expected, selection based upon high levels of production in a favorable environment produces a much different genotype from that of the same selection carried out in an adverse environment. Unfortunately, much more is known about the former process than the latter.

Only when more is known about the inheritance of adaptation will we be able to maximize the performance of F<sub>1</sub> crossbreds by ensuring that superior production animals are mated with animals possessing superior adaptation to harsh environments.

While some of the reasons behind the phenomenal superiority of the F<sub>1</sub> crossbreds are only now being uncovered, the need for adapted breeds to produce the desired heterosis has been recognized for many decades. For livestock producers or livestock ministries, systematic breeding programs that maintain a high level of heterosis represent a necessary part of a practical production system. For geneticists, it is a field of unlimited opportunity for breeding healthy livestock and for scientific research.

#### Breeder Organizations

One of the reasons why animal breeding technology has not been applied to indigenous breeds is because financial resources for breed improvement have not existed where these breeds are located. There may also have been some lack of interest, reflected in the absence or weakness of livestock breed societies. However, it is ironic that one of the reasons for the lack of breed organizations in the developing world is the poor reputation that breed societies encountered for a brief time in the industrialized world. Many graduate students from developing countries who were studying animal breeding in the industrialized world during the 1950s and 1960s came home with the impression that breed societies were harmful because they were putting far too much emphasis on breed type and show-ring standards than on performance characteristics. A new generation of scientific animal breeders in the 1950s and 1960s demonstrated beyond all doubt that many prize-winning animals of all breeds were actually below average in transmitting abilities for high levels of performance and breed societies at the time were held up to ridicule. But by the beginning of the 1970s, most had adopted objective performance recording systems and genetic improvement programs based on economic traits. However, in the developing world, the stigma of the old-fashioned breed society lingers on, and it is often difficult to convince well-placed officials that the impressions they gained two decades ago are no longer valid.

Gradually, however, the organization of farmer-breeder associations is being accepted as a modern alternative to breed societies. With this movement, it is possible that indigenous breeds can be put in good genetic condition for fair comparisons with exotics. But until such time as fair evaluations of particular indigenous breeds become possible, development agencies would be well advised to regard local stock as potentially important genetic material on which the development of successful domestic livestock industries will likely depend.

### Production vs. Survival

The livestock industry might well profit from the experience of plant breeders who have already learned that high input and high production per hectare is not as important a criterion in the humid tropics as it is in temperate zones. With milking cows, for example, it has yet to be determined whether two native cows producing 2,000 liters of milk each per lactation are more economical than one exotic cow capable of producing 4,000 liters per lactation. Is the high-producing cow that has been selected for the short growing season of the temperate zone as suitable as two medium-producing cows that are adapted to a continuous growing season in the tropics? The answer can only be made in terms of survival probability or replacement potential. If the high producer has difficulty conceiving and thus has a long calving interval and dry period, her production per day of life is much less than her production per day of lactation. Unless production and reproduction can function simultaneously, production levels cannot be economically compared. In any environment, sustained production following regular reproductive cycles is the first prerequisite for economic livestock production.

The trade-off therefore must lie between survival and high production. There is no doubt that high production is in itself a stressful factor and particularly so in harsh environments. High production requires high metabolic activity and high heat production. In temperate climates, this metabolic heat can be more easily dissipated than is possible in hot and humid climates. When an animal fails to control its body temperature under the stress of high ambient temperature, high feed intake, close quarters and high production, its vital functions begin to fail. Tissue damage aggravates the situation, causing additional metabolic heat production and loss, through catabolism (molecular breakdown) of scarce protein precursors. Lack of coordination and physiological disability follow, causing a climactic prostration (exhaustion) and death in otherwise healthy animals.

### Preserving the Species

Many countries are now aware of the importance of indigenous genotypes. Seed stocks of both plants and animals are being maintained, but plant geneticists are far ahead of animal geneticists in this regard. The conservation techniques involved, of course, are basically different. In plant breeding, conservation of germ plasm of almost all kinds is possible, whereas in animal breeding the management of populations of adapted breeds is essential. Since the natural zones of adaptation often cross national borders, breed management becomes more than a national concern. Too often a breed degenerates because isolated populations in different countries are not linked by an effective breed organization. The lack of such an organization often rules out fair

evaluation of the breed. In the absence of an organization, native animals required for comparison with exotics are usually purchased at local markets. These culled animals are then taken to specially managed premises where the imported stock is adapted but local stock is out of place.

The situation is serious. In some of the once-famous breeds like the Sahiwal, no good breeding stock is available. The much acclaimed Shami goat, currently so profitable in family flocks, has no breed organization. Quality germ plasm, such as seed growers are providing in the plant sector, is not being provided from indigenous livestock resources because these populations lack the necessary management.

The urgency of filling this gap will become more evident as evaluation standards for comparing breeds and breeding systems become better suited to local conditions. If, for example, concentrated feeds are in short supply in a developing country, as they often are, livestock ought not to be evaluated with unlimited feed allowances as they are in the temperate zones. Severe feed shortages even in the humid tropics are not uncommon, and livestock there must be able to cope with irregular feed supplies. In hot dry climates, the stress on livestock is even greater.

A June 1980 consultation in Rome on the whole question of livestock genetic resources began setting forth some of the awesome requirements for maintaining adapted livestock populations. As in the plant field, international coordination is needed. To get this started at a time of economic stress means that it must be done without frills and with emphasis on the practical populations of farm livestock. This includes camels, elephants and donkeys whose development has been neglected because they are considered of little importance in the industrialized world. But with a changing energy picture, draft power may become as critical a criterion as meat or milk production in the selection of best-adapted livestock.

[Edited extract from Ceres, the FAO Review on Agriculture and Development, Vol. 14, No. 1, January/February 1981, pp. 15-18.]

## Embryo Transfers

Judith Randal

[Artificial insemination revolutionized selective breeding; now, live-stock scientists have developed techniques for embryo transfer that may match the impact of artificial insemination. The following article describes the mechanics and potential of these techniques.]

Before 1970--when left to their own devices--heifers never became pregnant. In 1980, however, an estimated 20,000 calves were born to unmated heifers. Under ordinary circumstances a cow can become a mother only once a year, but in 1979 a prize chestnut-and-white Simmental dam named Castille-156 produced 89 calves.

The explanation of the paradox is that a cow like Castille-156 bears none of these young herself. Instead, they are taken from her as speck-sized embryos and put into the uteri of other unbred cows whose monthly reproductive cycles coincide with her own. Although the substitute mothers are of undistinguished ancestry, the calves they deliver nine months later are purebred. The aristocratic cow serves as the reservoir of superior genetic material, just as the aristocratic bull does in the more common practice of artificial insemination.

This maneuver, called embryo transfer, is not new. It dates back to 1890 when an English biologist, Walter Heape, succeeded in making a Belgian hare produce a litter containing both purebred hare and purebred Angora young, and it has since been achieved not only in rabbits and cattle but in a variety of other species. It is only rather recently, however, that the technology has shown signs of becoming a major factor in animal husbandry.

Ms. Randal is a science correspondent  
for the New York Daily News and a  
syndicated columnist.

"The ups and downs of the cattle industry get most of the credit for this development," says George E. Seidel of Colorado State University's Animal Reproduction Laboratory in Fort Collins, one of 20 centers in North America that performed \$20 million worth of embryo transfer procedures in 1980. "Beef prices were so low in the mid-1970s that many ranchers reduced herd numbers. Now that those prices have risen, embryo transfer enables a cow of superior bloodlines to produce more calves. Often that is the only way that a rancher can reestablish a quality herd in a reasonable length of time."

The situation in the milk industry is somewhat different than that in the beef industry because there is less tendency to introduce exotic breeds like the Simmental (a promising line of beef cattle) and there has been no shortage of dairy cows. Nonetheless, dairymen also are increasingly drawn to embryo transfer as they discover that it can increase the number of offspring from a cow of superior genetic distinction, fetch handsome profits from the sale of her progeny, or prolong the reproductive life of a valuable, injured, or aging animal.

"A cow that is a good milker is often middle-aged before the owner knows whether her heifers can be relied on to turn in the same desirable performance," explains James Evans, whose embryo transfer service at the University of Pennsylvania is one of the most active. "With embryo transfer, the farmer can make up for that lost time. In fact, whether the client is in the beef business or the dairy business, embryo transfer can compress into a few years what used to be a life's work of building a good herd."

How is it done? At first it was just a matter of breeding the donor cow, either naturally or artificially, and recovering her embryos three times a year, thereby tripling her normal calving ability. However, her productivity can be increased further by injecting her with follicle-stimulating hormones from the pituitary glands of slaughterhouse animals or gonadotrophin from the blood serum of pregnant mares. Both of these hormones are used also in the treatment of human infertility and either one will "superovulate" the cow, causing the ovaries to release more than one egg. When the cow is bred, most of these ova are fertilized.

A few years ago it was standard to collect the embryos surgically, but this practice has been abandoned because of the considerable risk that the operation will compromise the cow's future fertility. It is safer to introduce buffered saline solution into the reproductive tract and wash the embryos out. Using this method, an animal can serve as a donor repeatedly and be none the worse for wear.

One June morning, for example, a superovulated Simmental that had conceived the week before in West Virginia arrived by truck at Evans'

New Bolton Center treatment barn. There she was led into a narrow stall and given an epidural, a kind of spinal anesthetic also used in human obstetrics. Evans put on a shoulder-length plastic glove and reached through the rectum to examine the cervix and uterus. At about one two-hundredth of an inch in diameter, the embryos were too small to be felt, but by examining the nearby ovaries Evans could tell that the cow was pregnant. He introduced a long, flexible latex catheter into the uterus and forced saline fluid through it. As the fluid drained out, it carried embryos with it. In an hour, her uterus flushed ten times, the Simmental was back on the truck and ready to leave.

An assistant searched the fluid for embryos. As he located each one, he sucked it up in a glass pipette and placed it in a separate receptacle to be reexamined. Only embryos that look healthy over the course of several hours--as all of these did--are retained.

The heifers that would receive the embryos were waiting in the wings. All of the mothers-to-be were unpedigreed Holsteins, because the breed has wide hips that facilitate delivery of the large Simmental calves, and because Holsteins have placid dispositions and a generous milk supply. Each heifer was confined in standing position and examined, as the Simmental had been, to locate the ovary that had been active in estrus. Using local anesthetic, a six to eight-inch incision was made in the flank on the same side as the heifer's producing ovary.

The embryos had been placed individually into long, thin, metal tubes fitted with a plunger. As each tube was inserted through the incision of one of the Holsteins and the plunger pushed, an embryo was deposited in her uterus. The heifer was now pregnant, but it would be 40 days before Evans could be sure the embryo would survive.

A new technique was added to cattle embryo transfer with the birth last June of the first "test tube" calf at the University of Pennsylvania's New Bolton Center. Holstein egg and sperm were combined in a glass dish and transferred to a recipient cow. Since less sperm is needed for *in vitro* fertilization than in artificial insemination, a single bull can thus produce more offspring.

Currently, the cost of an embryo transfer--about \$2,000 per recipient--is greatly increased by the need to keep 20 potential recipients on hand for every embryo. Cows ovulate every 21 days and the donor and recipient can be no more than 24 hours out of estrus phase. Since all those recipients must be kept in top reproductive condition while awaiting pregnancy, this does not come cheap. This cost can probably be considerably reduced, however, when the following methods are used. The recently marketed drug prostaglandin F<sub>2</sub>alpha resets the timing of the reproductive cycle, eliminating the need to keep so many reserve animals (the drug must be administered before the recipient needs are known).

Also, freezing the embryos in liquid nitrogen makes it possible to store fertilized eggs and match them with recipients in natural hormonal readiness at the breeder's convenience. Healthy calves have already been born from embryos kept for a year of suspended animation in a freezer, and similar trials in goats and sheep have resulted in the birth of normal young. Pregnancy rates after the transfer of frozen livestock embryos are less than half those with unfrozen embryos; but simpler, more effective freezing methods are being sought and will cut the costs of embryo transfer drastically.

Embryo transfer is already sufficiently flexible to be paying some surprising dividends. One of these is that it is ideal for quickly testing bulls for undesirable but hidden traits that they might transmit to their progeny: for instance, hereditary dwarfism and hoof deformity. When a cow can be made to superovulate and the resultant eggs are fertilized by semen from a test bull, the question of the sire's genetic makeup often can be resolved in a single year. Since some bulls commanding high stud fees contribute their gene pool to hundreds of calves, a great deal of money can ride on the outcome of the trial.

Embryo transfer also is being used in pig breeding. Two American veterinarians, Jason James and Philip Reeser, worked with sows that had grown too old to be brood sows but could continue to conceive when they were inseminated. By recovering their embryos and surgically transferring them to younger females better suited to motherhood, James and Reeser were able to prolong the productivity of genetically superior procine dowagers by an average of 50 offspring each. Some of these elderly sows have served as embryo donors as many as ten times.

Farmers in many countries are eager to improve their livestock but generally are not permitted to import animals for breeding because of the risk of communicable disease. The fertilized eggs are thought to be protected from many of the infections that newborn calves and piglets can pick up from their mothers. Besides, cattle and swine travel far more cheaply as embryos, and they probably are healthier if born into the circumstances in which they will spend their lives. On the other hand, embryo transfer takes a great deal more time than importing livestock. Cattle and sheep embryos have been shipped from Britain, the United States and Canada to many parts of the world.

Although the broad principles of embryo transfer are the same for all mammalian species, each species has its secret differences that only persistent study will disclose. Medical researchers would like to have embryo transfer technology provide them with a plentiful supply of animals--particularly primates--to serve as study models of human disease.

Wisely deployed, embryo transfer technology can speed up the generation of both valuable information and valuable animals. Foolishly deployed, it could become a faster way to make potentially serious mistakes.

[Edited extract from Science 81,  
Vol. 2, No. 9, pp. 86-92, Copy-  
right© American Association for  
the Advancement of Science, Wash-  
ington, D.C., 1981. Excerpted  
with permission of Science 81.]

## Raising Chickens in the Bush

Stephen Frye and Donna Gessell-Frye

[Chicken production, both for eggs and meat consumption, can be a relatively small-capital, labor-intensive venture in rural areas or near towns. The following article describes how to establish, maintain and reap benefits from a chicken-raising project.]

Local fowl in Fiji, as in many parts of the developing world, run around free in almost every village. These birds are strong in survival instincts, but have very little meat, lay few eggs, and the eggs they do lay are usually hard to find. In addition, there is a high mortality rate among these birds because mongooses and rats can consume a majority of the young chicks. Attempting commercial management techniques with these chicks, such as enclosing them or giving them commercial feed, is simply not economical. However, raising commercial birds on commercial feed in the bush can be a paying proposition, and can be done on a small scale within the means of the local farmer, while utilizing locally available resources.

The system of raising chicks described below can be used as a good starting point, and can later be expanded if desired. It is a small-capital and labor-intensive venture and can provide a quick turnover of money and supply a steady income. There is a definite risk involved, as disease or disasters can dramatically reduce the flock and wipe out the profits, but with the proper management and care this risk can be minimized.

If you decide to keep chickens, the first thing to check out is the market. In most villages, a market can

Mr. Frye and Ms. Gessell-Frye are  
with the U.S. Peace Corps, in  
Fiji.

be developed because most people want chicken meat and eggs if they are available at reasonable prices. If your area is near a major town, you might have trouble competing with the larger commercial farmers, although this might also offer you a larger market later after you learn the business. Some adding and subtracting will determine the cost, and a check against local prices will indicate whether chicken-raising looks feasible.

Before starting a chicken project, you have to decide whether to grow meat birds or egg layers. The major advantage of meat birds is that they are quick to raise because they are of a marketable weight and size at nine weeks of age. They are a bigger risk than layers, however, because they are more susceptible to diseases, which can keep them from gaining their maximum weight. Also, the market for these chickens may be more sporadic where most meat in the village is consumed for ceremonies or semi-special occasions, so it may take you three to four weeks to sell the flock. Because meat birds provide a quick turnover for your money, you may want to start with them in order to raise the capital for layers.

The big disadvantage of the layers is that there is a six-month wait before you see an egg. But when they do start laying, you should have a steady supply of eggs for at least a year. Raising layers can contribute to village health because the eggs will find their way down to the younger children before the meat will. Eventually you should try both meat birds and layers; if you master the subject, you'll recover your investment and even make some money to reinvest.

#### The Brooder

The day-old chicks can be acquired from a hatchery. This is the best method, as opposed to hatching one's own, because the equipment to run a hatchery is expensive and cannot be used to raise the chicks once hatched. [Note: We are assuming here that a hatchery is in operation in your country where selected breeds of good producing chickens, well graded and of reliable quality, can be bought for a reasonable price. If this is not true, much of the advice given below will not apply.] The laying chicks should have been sexed at the hatchery so that the farmer should receive females only, but he can expect 2% of the order to be males due to error. Although a rooster helps to keep the layers in line and stop fights, he is not necessary for the hens to lay eggs. They do add to the noise problem, and fertile eggs spoil faster, so it may be wiser to dispose of the roosters. Getting rid of the rooster may lead to many conversations trying to convince people that he is not needed for the hens to lay. The hatchery should give layers the vaccinations necessary for a healthy flock (discussed below). Meat birds come in both sexes and this is acceptable because they will be sold before the roosters can cause any problems. The meat birds do not automatically get the vaccination, but these vaccinations can be given for

an additional charge. Where they are sexed and automatically vaccinated, layers are more expensive than meat birds.

Chicks do not need food, water, or heat for about 24 to 48 hours after hatching so this is the perfect time to transport them. The chicks should come in a box, litter-filled, with holes for ventilation; one box generally holds over 50 chicks. Care must be taken to keep the boxes level, especially if transportation is going to be a long and involved process. It is imperative that the boxes stay dry at all times. Water, food, and heat must be provided after the 24-to-48 hour time period, or as soon as they are settled, whichever comes first. If at all possible, the chicks should be in their home by the end of the 48-hour period.

The brooder is an enclosure for the young chicks that is equipped to fulfill all the responsibilities of the mother hen. It must be warm, dry, and mongoose and rat proof. If a small chick gets cold or wet, it is likely to die. If a large enough crate can be found, it will work well for a brooder. If not, an enclosure can be made by placing a few boards in the corner of the house to form a box. The walls should be approximately 500mm (20in) high. The enclosure or box should be lined with old cardboard boxes around the walls and on the floor. Corners should be rounded out with the cardboard because chicks tend to lie on top of each other when cold, and the ones on the bottom in a corner can be smothered. One of the easiest ways to keep the chickens safe and well is to put the brooder inside the farmer's house. The presence of people will scare away a mongoose, and the effort of building a fortress-like brooder will be saved. An inside brooder is also easy to keep dry and draft-free.

The floor of the brooder should be filled with some litter material 75 to 100mm (3 to 4in) deep. The cardboard under the litter will help when it comes time to dismantle the brooder and clean up. The litter provides insulation and comfort for the birds and also absorbs their droppings. Dry and dustfree materials such as peanut hulls, rice hulls, fresh sawdust or shavings, cane pulp, bagasse, or dry sand will work. Sand is especially good because it helps develop the young birds' gizzards. Laying paper on top of the litter when the birds arrive will help the chicks differentiate between the litter and their food, and will also add a little extra insulation. Adding an extra layer of litter after three or four weeks will help prevent odors.

Warmth. The chicks must be kept very warm. In their first week they prefer a temperature near 35 degrees C. (95 degrees F.). The temperature can be lowered about 3 degrees C. (5 degrees F.) each week thereafter until they are totally weaned from the heat to the local temperature. In some areas, two kerosene lanterns burning night and day are necessary at the beginning; as the chicks' need for heat lessens, one lantern may be used continuously, and finally one lantern just at night will do. These lanterns can be simple kerosene storm lanterns, or elec-

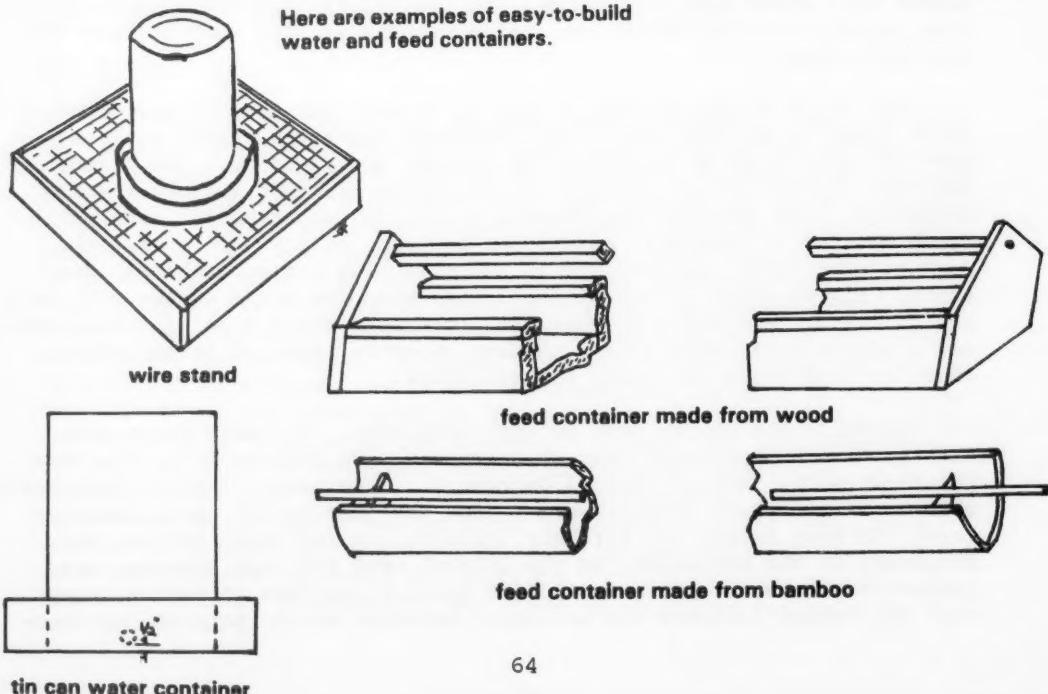
tric light bulbs. A metal cover of some type, such as a sheet of roofing iron, can be added to the brooder to keep the heat in.

The easiest way to judge the temperature in the brooder is to watch the chicks. If they are bunched up against the lanterns, then they are too cold. Conversely, if they are spread out to all corners of the brooder they are too hot. An equal distribution around the entire area is ideal. An uneven distribution is an indication of a dangerous draft. If the chicks get too hot then they will start to "paste up," that is, the feces will stick to the rear end of the chicks. When pasting occurs, the feces should be washed off and the heat reduced. Overheating causes dehydration and can kill a chick if allowed to continue. The chicks should feather out and be weaned from the heat after a four-week period, or less in the hot season.

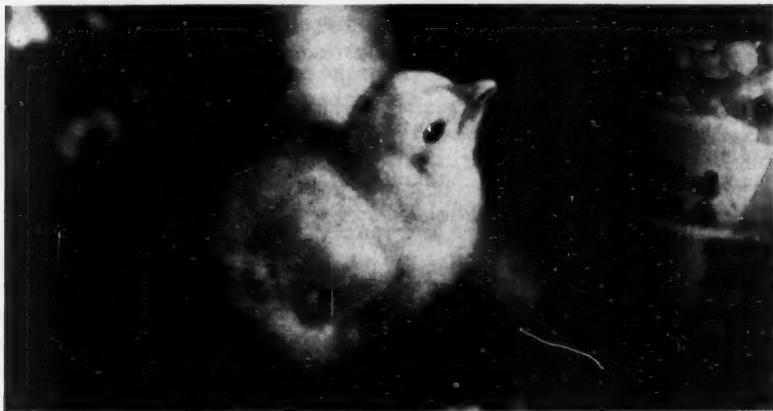
Feed and water. The brooder must contain feed and water. For the first few days, egg cartons or plates may be used as feeders. These first feeders should not have sharp points on their edges which can prove deadly to young chicks. The chicks will eat and sleep in these containers.

As the chicks grow a little larger, the feeders must be constructed so that the chicks cannot walk around in them and dirty them. Feed loss can be reduced by making sure there is a lip on the feeder. This helps prevent spillage and waste as the chick pulls the feed toward itself. The feeder should be designed so that it can "grow" with the chick; the lip of the feeder should always be at the same level as the back of the chick. The illustration below shows how to construct two easy-to-build feeders.

Here are examples of easy-to-build  
water and feed containers.



From the start, the water containers must be built so that the chicks cannot get into them and get their feathers wet. It is helpful to design them so that the chicks cannot get on top and dirty the water from above. The water container should also be adjustable to "grow" with the chicks. Placing the water container on a wire stand as the birds get older helps to prevent wet litter. The water container should be rinsed and refilled at least once a day to provide the chicks with a steady supply of clean water. This is necessary to prevent dehydration and disease.



*This day-old chick is drinking from a water container designed to keep the chicks out.*

Other problems that can occur, especially as the chicks get older, are toe-picking and feather-pulling. These habits can lead to cannibalism and death. These problems can largely be avoided by keeping the litter clean and by providing adequate amounts of clean water and feed. Suspended newspaper strips, empty tin cans or lids, anything that will attract their attention and encourage them to peck at it, especially any bright, shiny objects will divert the chicks and reduce problems. But if the chickens continue to attack each other, debeaking may be necessary. Debeaking can be done at any time, but it is best done between the second and sixteenth week. It consists of cutting off half of the upper beak and just the tip of the lower beak to blunt it. To avoid bleeding, the beaks must be cauterized using a red-hot nail or knife. If cauterizing is not possible, then only a small portion of the upper beak should be cut, a temporary measure which will have to be repeated when the beak grows back. If the chickens are to range, however, they should never be debeaked.

Meat chicks should stay in the brooder until they are four weeks, and the layers until six weeks of age. This period in the brooder is

the most crucial time in raising chickens. This is when the greatest mortality occurs, so it is most important to keep the chick's surroundings dry and clean and to make sure they have ample feed and water.

#### The Coop

When the chickens are weaned from the heat and are large enough not to fall through the slats, they can be moved into their chicken coop. The requirements for the coop differ somewhat from those for the brooder, but again the chickens must be kept dry and safe from predators. Their surroundings should be clean and disease-free.

There are several methods of housing chickens, but not all are totally satisfactory. For example, continuing the use of a deep litter is not satisfactory because the litter exposes the chickens to their droppings where diseases breed. These diseases breed especially fast in the tropics. But raising chickens on a range system, or running free, also has disadvantages, because the chickens become easy targets for mongooses and rats. Because commercially desirable chickens have been bred to lay a great quantity of eggs or to gain a great deal of weight quickly, they have lost the ability to live in surroundings closely resembling natural conditions. Also, chickens do not have the ability to sweat, and therefore have a limited ability to cope with high temperatures, making it important to keep their environment as cool as possible.

A house with a slatted floor raised above the ground is the most efficient type of coop for tropical bush conditions. The chickens are raised up away from the dangers of mongooses and other predators, and the chicken droppings fall through the floor out of the chicken's reach. The raised floor also facilitates the removal of the chicken manure, which is a valuable fertilizer, especially for tropical soils. A raised house also reduces the need to stagger batches because of reduced disease incidence.

Location. The first question to consider when building the coop is location. The coop should be at least twenty meters away from any house because a chicken coop attracts flies. The coop should be built in a spot protected from any strong winds that might blow through it. A further consideration is the convenience of transporting bags of feed and water to the chicken house. If you're raising meat birds and layers in the same area, the two varieties should be separated by at least two hundred meters because layers harbor diseases that could be disastrous to meat birds. Also, different age groups of the same kind of bird cannot be placed in the same coop.

Construction. The floor size of a raised house should allow a minimum of 4 laying chickens per square meter ( $2\frac{1}{2}\text{ft}^2$  per layer) or 10 meat

chickens per square meter (one per ft<sup>2</sup>). In the tropics, more room should be provided, if at all possible. The floor must be at least a meter off the ground and the roof of the house one meter above that. Before starting construction, the ground underneath the coop should be prepared by putting down a layer of compacted clay. This will make it easy to scrape the chicken manure out from underneath the coop. Ditches should be dug around the coop to keep the site drained.

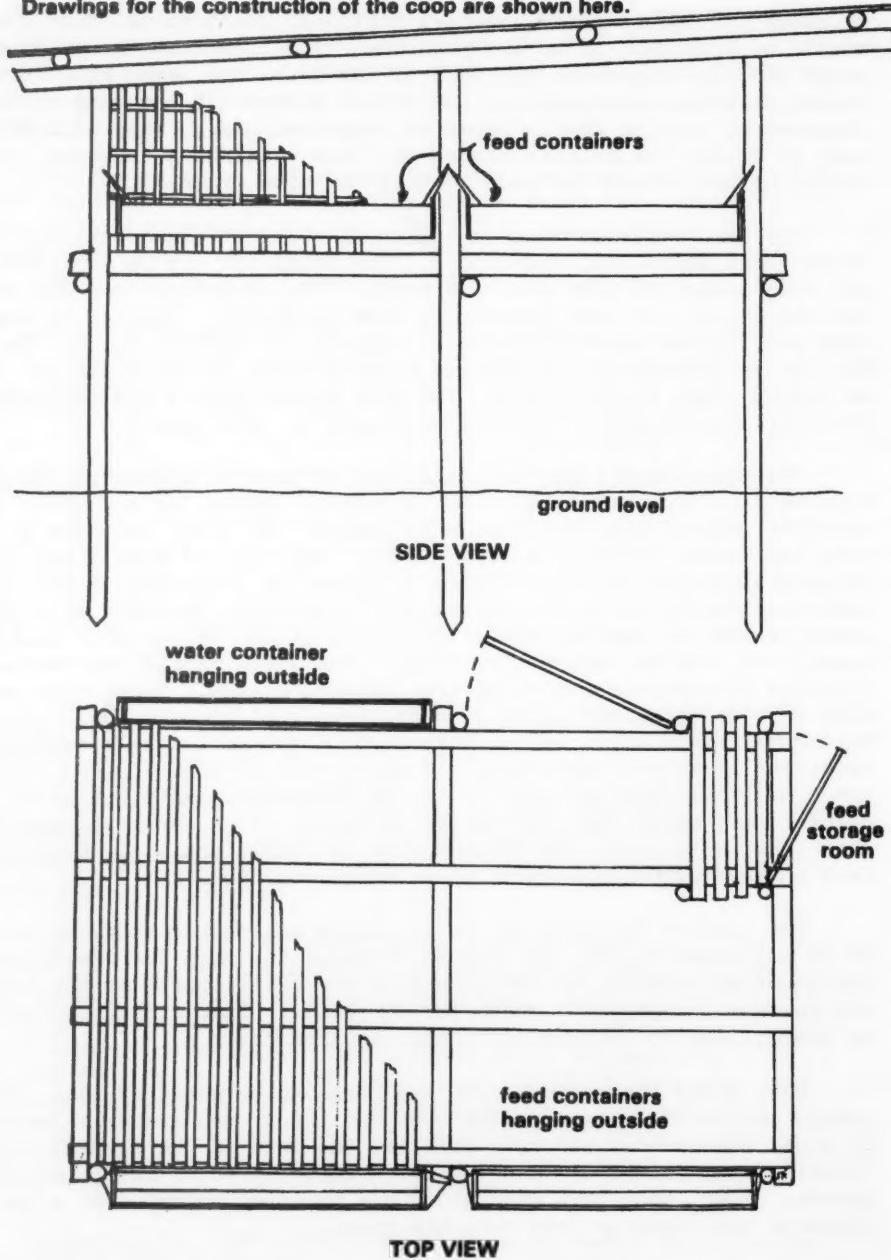
The basic chicken house consists of a wooden framework, with open-weave floor and walls, and a roof. The framework can be made from posts and sawn lumber or from all bush woods. The structure consists of six upright posts with wood connecting them widthwise. Running on top of this wood is the understructure to support the slatted floor. The wood for the understructure should run perpendicular to the slats and should be spaced every 600mm (2ft.). The roof should have a similar under-structure for support. (See illustration on next page.)

The open-weave floor and walls can be made of commercial chicken wire or from local materials such as bamboo, reeds, or any other small straight poles. When building with bamboo, the slats are made by splitting the bamboo lengthwise into sixths. Openings of 40mm (1½in) are necessary between the floor slats to allow the droppings to fall through. Each slat should be nailed separately, otherwise, chickens will move the slats around and make escapes. The walls attach to the post with a slat spacing of 40mm to 60mm (1½ to 2½in). The slats should run vertically, allowing the chickens to reach the feeders outside. These open walls also provide excellent ventilation to keep the chickens cool. A few horizontal slats woven in can help to hold the entire wall together, and to attach it to the structure. If using chicken wire instead of slats, use 40mm(1½in) wire and nail it to the framework. Although using chicken wire makes the coop easier to build, it is far more expensive than local materials, and chicken wire can cause unsightly breast blisters on meat birds, something that bamboo does not.

The roof of the coop can be as simple as roofing iron, or it can be of any local design, as long as it keeps the coop dry inside and has enough of an overhang to keep the rain out of all parts of the coop and the feeders and provides shade for the birds. An overhang of two feet is the minimum to satisfy all these requirements.

Even after the chickens are too large to be eaten by rats, rat guards on the poles between the coop and the ground are still necessary. If given the chance, the rats will eat the feed in the feeders. 30mm (12in) of tin or old tin cans nailed around the posts make good rat guards. Also, take care that there are no trees nearby that a rat or mongoose can climb to jump onto the coop.

Drawings for the construction of the coop are shown here.

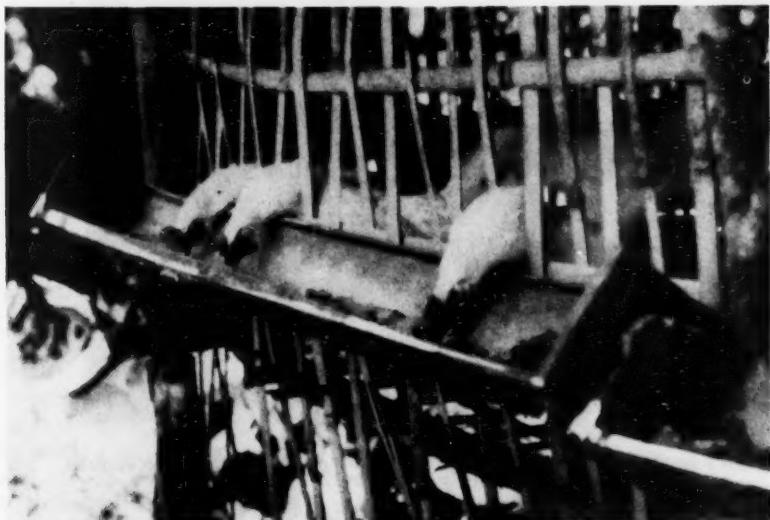


Feeders. For ease in feeding the chickens, it is helpful to have the feed in the same building. It is a simple matter to build a small storage room at the end of the chicken house. It must, however, have substantial walls to separate it from the chickens. These walls could be made of bamboo, but with a tighter weave than the rest of the walls of the coop. As not more than one month's supply of feed can be kept at one time due to pests and the loss of vitamin potency, the room does not need to be very large, about 450mm x 1m ( $1\frac{1}{4}$  x  $3\frac{1}{4}$ ft) will do. This area has to be kept dry because the feed will rot and mildew if wet.

The feeders and water containers are best placed on the outside of the coop in such a manner that the chickens can stretch their heads through the slats to eat and drink. This not only keeps the chickens from walking or roosting in them, thus reducing the amount of cleaning necessary and the waste of feed; it also makes it more convenient to watch and fill the feeders.

The feeders may be made of two long pieces of 6x1 inch wood nailed together edge to face to form a long trough. Since a great deal of feed can be spilled out the ends, it is wise to extend the end plates above the rest of the trough. The feeders must have some kind of lip on the edge near to the birds.

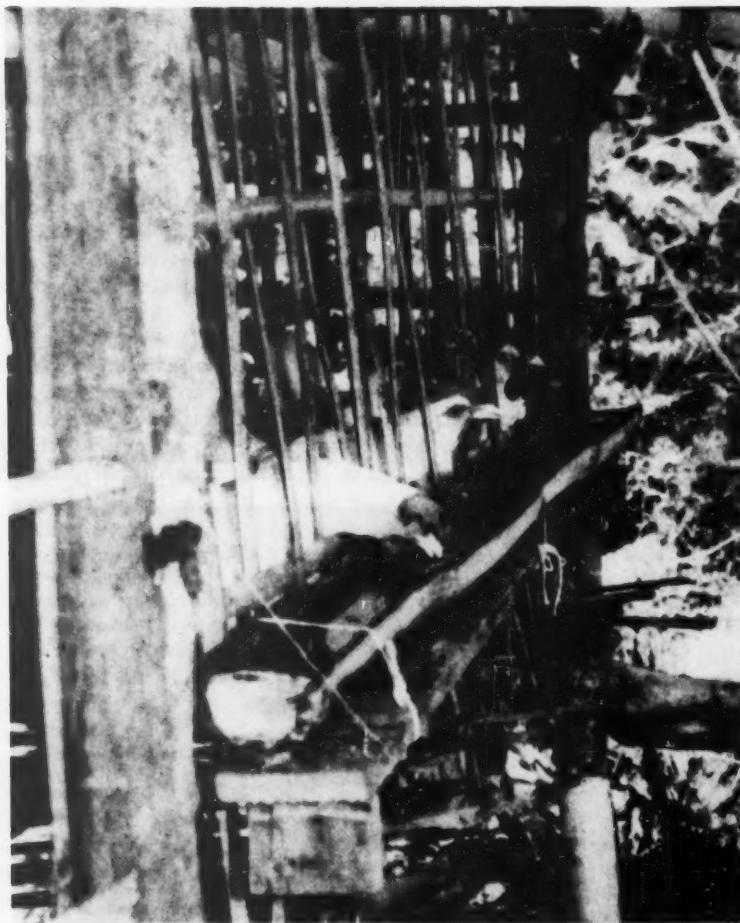
To prevent spillage, the feeders should never be filled more than half way full. The bigger the feeders, the less often they have to be refilled. However, they cannot be too deep or the chickens will not be able to reach inside. An extra piece of bamboo or wood inside the coop, running parallel to the feeders, will make it easier for the chickens to



*This feed trough is made from 15.5cm x 2.5cm (6in x 1in) boards nailed on edge, with a bamboo lip nailed onto the side close to the hens.*

stand facing the feeders while they eat. The feeder should be mounted so that it can be moved upwards as the chickens grow. The chickens will work hard to keep the feeder box clean all the time.

The water containers can be made of bamboo hung on the outside of the coop. They should be on the opposite side of the coop from the feeders so that feed does not get into the water. Containers should be removable for easy cleaning. The bamboo should be about 100 to 150mm (4 to 6in) in diameter.



*A bamboo trough is used to supply water to the birds. They should always have clean water available.*

The maintenance of the coop is relatively simple. The water containers need to be cleaned out once a week or whenever scum starts forming in the water. The chickens will take care of keeping the feeders clean. About once every three to four weeks, the storage area for the feed should be cleaned out with a disinfectant in order to break the cycle of bugs and maggots in the feed.

The manure underneath the coop should be gathered up and used at least once every six days to disrupt the breeding cycle of the flies. Bamboo can be used to make a scraper for scraping up the droppings.

If the coop is to be reused for another flock of chickens, it must be thoroughly cleaned with a disinfectant before the new birds are placed in the coop, so that no diseases are passed on to the new flock.

#### The Feed

The question of whether it is better to raise chickens on commercial feed as opposed to local feeds, is mainly one of economics. Mixing feed from local materials is cheaper than buying commercial feed, but is time-consuming work with an uncertain outcome. The biggest problem is combining the proteins and minerals into a balanced mix that the birds can fully utilize. Raising a food crop specifically for use as a protein source for the bird feed may or may not be practical.

One way to utilize local feed is to raise the chicks on commercial feed for six weeks, and then supply them with local feed and let them "range," or run loose. This lets the chickens balance their diets by pecking for what is missing in the local feed. However, besides the obvious problems with predators mentioned before, this form of management will also affect the birds' production. They have to work for their food, using up energy that would otherwise be used for growing or laying, and may not be able to fill all of their food needs.

Unfortunately, the mixture of artificial feed with local feed does not often work out, because it usually mixes up the protein levels of the feed so that the birds cannot utilize all the protein they consume. By supplying all the feed requirements of the chickens with commercial feed, raised houses can be used efficiently because the birds never need to leave the coop. There is also a better feed-consumption/weight-gain ratio with the carefully balanced feeds.

Some of the ingredients in commercial feed are: molasses, sorghum, peas, coconut meal, maize, tallow, milk powder, meat and bone meal, bran, pollard, bloodmeal, fish meal, soya meal, pea meal, a vitamin premix, and a mineral premix. The feeds generally come in three forms--pellets, crumbles and mash. Crumbles should be used for the young birds in the brooder where the bits that fall into the litter can be utilized.

Mash is similar to corn meal in consistency, and although it is sometimes cheaper to buy, more is wasted. The most economical way of feeding the older birds is pellets--because of the compact form, there is less waste. The young birds, however, are unable to eat the pellets because the pellets will stick in their throats.

There are different feed programs for meat birds and layers. The meat birds should be fed a high protein feed (21%) from the time they are one day old until they reach four weeks of age. The chickens grow quickly, producing their most dramatic weight gain during this period. A reduced protein content feed (18%) should be used after four weeks and until the birds are sold. All of the feed for meat birds should contain a coccidiostat to prevent coccidioses from breaking out in the flock.

For the first six weeks, the layers should be given a 20% protein mix to ensure quick growth. It is the only layer mixture that need contain a coccidiostat. During the five-to-seven week period, the chickens should be switched to a 16% protein mix. This feed should be used until the chickens reach the laying stage. It is important to change promptly to a layer feed when the first few eggs are seen, usually around the twenty-first or twenty-second week. This feed should have the extra calcium needed for the production of the egg shell. It should not be given too early, however, or it can cause kidney problems.

As the birds get large, their feed consumption increases dramatically. It can be assumed that a broiler will consume 6 kg (13 lbs) of feed before it is ready for sale. All the feed calculations are approximate, because feed consumption can be influenced by factors such as the strain on the birds, their general health, and the temperature of the coop. Careful records of the feed consumption should be kept to provide a clear understanding of the costs and profits of raising chickens in a particular situation.

#### Broilers

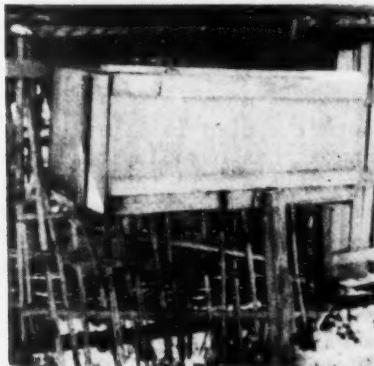
It is usually most profitable to sell meat chickens as young birds of small size called "broilers." After eight to twelve weeks, the broilers' rate of weight gain slows down to the point where it no longer makes sense economically to continue feeding them. If there is any shock or strain on the chicks, the weight gain will be permanently slowed down. If the shock is unavoidable, then a solution of multi-vitamins dissolved in the water can be helpful to reduce the effects. Also, more care with the flooring is needed because these birds have thicker but weaker legs than layers and are more prone to leg and hip problems. The weight they are allowed to reach should be determined by the local market. The efficient feed/weight ratio is usually reached when the birds are 2 to 2.5 kgs (4 to 5 lbs).

It can be beneficial to the village to raise one or two hens to interbreed with the local stock. This will strengthen the local breed, combining their native instinct for survival with the commercial birds' ability to gain weight fast. The offspring will not be as efficient weight gainers as the commercial birds, but they should be able to better survive the local conditions.

### Layers

As the layers approach their twenty-first or twenty-second week they should start laying eggs, and by the twenty-sixth week they should be at 50% production (100% production would be one egg per hen per day). As the layers grow older, they can be expected to lay 70-80%. When young, chickens lay many small eggs, but gradually, during the following year, switch to laying fewer but larger eggs. To make efficient use of the eggs, the farmer must recover all the eggs that are laid. Frequent collection of eggs, and a proper laying place increases the efficiency of egg production.

The hens need a place that is dark and cool and filled with clean, dry nesting material. The nest should be easily accessible--both for the hens and for easy egg retrieval and cleaning. To save floor space, the nesting box should be raised about 1 meter (39in) above floor level. A roost must be placed in front of the box so that the birds have something to land on when they fly up to the box to lay; this can be a wooden stick small enough for the birds to grasp. One possibility is to use a crate for a nesting box. The crate can be built if one is not available. The advantage of using a crate is that the back side can hang outside of the coop and be hinged, so that the eggs can be removed and the nests can be cleaned from the outside. Thirty birds need one



*The nesting box viewed from the outside where the eggs are removed. The box is placed high so it doesn't take up floor space, and the chickens enter through the two holes after first landing on a perch built on the other side.*

square meter (3 birds/ft<sup>2</sup>) of nesting area. At least two holes 200mm (8in) in diameter are necessary for the entry of the chickens. A lock can be put on the box to secure the eggs from the prying hands of children or others.

Clean nesting materials, periodically replaced, must be kept in the nesting box. If too little nesting material is used, eggs are likely to break. This leads to the hens eating eggs, a habit that once started is hard to stop. An extreme solution to this problem is debeaking.

The openings to the box should be covered up until a couple of eggs are seen in the coop. It may be necessary to induce the chickens to go into the box for the first time by hanging shiny objects in the case so that they can be seen from the coop floor. Chickens raised on a slat floor will always go to the softly nested box to lay eggs. However, it is sometimes necessary to encourage the hens to return to the box in the beginning of the laying period. This can be accomplished by leaving an old light bulb or a stone resembling an egg in the box. They will mistake it for yesterday's egg and will continue to lay there.

During the laying period, the birds will consume a great deal of food. If their food supply is disrupted or their health impaired, egg production will be affected. Therefore, it is important to keep the birds healthy and well-fed during their entire laying period. Since a major part of the egg is water, it is equally imperative that clean water always be provided. A disruption of water supply, or too much dirt in the water can also affect egg production.

Culling. It is sometimes necessary to cull (remove) the non-producers from a flock. Because of the cost of supplying feed to the birds, you cannot afford to feed a bird that is laying few or no eggs. Care should be taken before deciding to kill the bird, however, because many times the bird is just in a rest period and may soon resume laying eggs. It might be wise to isolate and observe the bird for a while before making the final decision.

There are several signs that tell whether a bird is laying a great many eggs or just a few, and how long it has been laying or not laying. Looking at the pigmentation of the bird should indicate how long it has been laying. As the bird starts to lay eggs, the yellow pigmentation is diverted from the chicken to the yolks. This bleaching of the different parts of the body occurs in a definite order, and can indicate how long the bird has been laying. The vent (i.e. anal opening) bleaches out in the first few days, and the eye rings follow. After approximately three weeks the ear lobes bleach out, and then the beak. If a bird stops laying, the pigmentation returns to these body parts in the reverse order.

The chart that follows gives signs that indicate whether the hen is a high or low-egg producer.

Body part	High producer	Low producer
Vent	bleached, large moist	yellow, dry, puckered
Pelvic bones	two fingers apart	close together
Eye rings	thin, bleached	thick, yellow
Beak	bleached	yellow
Plumage	worn, dry, soiled	smooth, glossy unsoled
Comb and wattles	large, red, prominent	small, pale, scaly
Back	wide all the way to the pubic bone	narrow, tapering to the rear

Moultting. After ten to twelve months of laying, the hens will go into moult, replacing their old feathers with new ones. The better the layer, the later the moult will be. During the moult process, the hen will not be laying eggs, and after the moult the second year, the amount of eggs will drop, but the egg size will be larger. Some growers sell their flock at the end of the first year and buy a replacement flock, while others keep a highly productive flock for two years.

#### Health of the Flock

When raising chickens, the saying "an ounce of prevention is worth a pound of cure" is well worth remembering. If the stock is vaccinated, the surroundings kept clean and dry, and water and feed always provided, then the chances of disease are greatly reduced. A disease in the flock can be detected by a drop in feed consumption, followed by a drop in egg production, and sickly appearance of the chickens, who eventually die. Under tropical conditions, even when raising a healthy flock, a certain loss is to be expected, somewhere between 5-10% per year.

The first step towards a healthy flock is to make sure that the chicks are vaccinated. Major diseases may include Marek's Disease and Fowl Pox. Both of these diseases have no cure and the only method of prevention is vaccination. Marek's Disease causes a paralysis that freezes one leg in front of the body and the other behind. The vaccination is 80% effective. Fowl Pox causes black growths on the back of younger birds and on the combs of older birds. It can affect the growth or the laying cycle of the bird.

Another disease problem is coccidiosis, a parasite that is picked up from chicken droppings. If the chickens are raised above the ground and removed from their droppings, there is still a chance that they will contract this disease. If the spacing of the floor slats is not sufficient, and not enough of the droppings fall through, then the chickens might get coccidiosis. Chickens with coccidiosis start by looking sickly. Their feathers are rough and dull, they have little vitality, and their feed consumption drops off. The birds stand hunched over, with their

tail feathers drooping. The birds appear as if chilled, crowding together in smaller bunches. Blood usually appears in the feces, and soon after the birds die. Those that survive will be immune to the disease thereafter. The treatment for the disease is a coccidostat, which is basically a sulfa drug. The commercial feed for the meat birds contains a coccidostat, so it should not be a problem in raising broilers.

Another possible health problem with chickens is worms. Here, also, raising the floor and separating the chickens from their droppings greatly reduces the chances of their getting sick. Roundworm is the internal parasitic worm that gives the most problems. The symptoms are similar to those of coccidiosis, but there is never blood in the feces and very rarely is it fatal. A piperazine compound given in the water will clear up the worms. Usually one worming is enough if the chickens are on slats.

It cannot be over-emphasized that if the birds are managed properly, provided with a clean water source, raised up on slats, and supplied with the proper feed, there is little chance of an outbreak of disease.

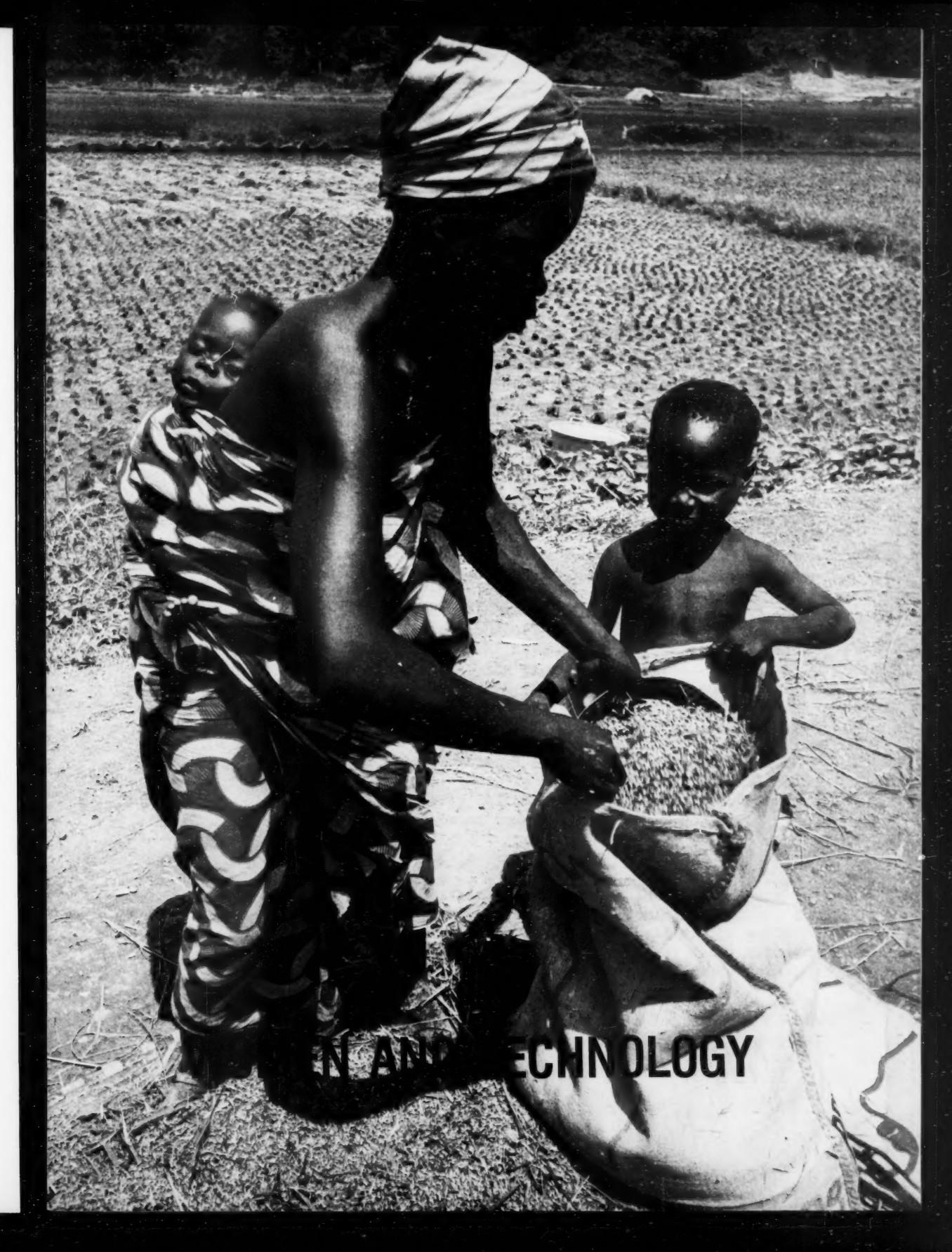
[Note: This article was written for conditions in Fiji; in other areas, different diseases may be found--for example Bluecomb, or Newcastle disease.]

#### Records

It is important that comprehensive records be kept of all chicken projects, especially the pilot project in an area. A simple account should include all money spent on the project and all money received, so that one can see whether a profit is being made and, if so, how large a one. This helps not only to determine the feasibility of raising chickens in a particular setting, but also to indicate where small changes may be needed to make the operation more profitable.

The records should include all costs: everything from the cost of chicks and feed, to kerosene and litter for the brooder, to housing costs when the chickens are put outside. Another important cost that can make or break a small operation in the bush is the cost of transportation, which must always be kept down to a reasonable level. Transportation costs include transporting the chicks, their feed and other necessary items to the site, and transporting the chickens or eggs to market. In computing the potential income, it should be remembered that the layers can be sold for meat at the end of their egg laying. Also, all eggs eaten by your family should be recorded as possible profits.

[Edited extract from Raising Chickens in the Bush, a pamphlet published by the U.S. Peace Corps, Fiji, 1981.]



**NATURE AND TECHNOLOGY**

WOMAN BAGGING RICE AT THE  
GBEDIN RICE PROJECT IN LIBERIA.  
(PHOTO: FAO -- G. TORTOLI)

## Women, Technology and the Development Process

Krishna Ahooja-Patel

[This paper delineates the significant elements of inequality of access to technical education and technological knowhow between men and women, and the need for policy measures to improve the technological knowledge and skills of women for higher productivity.]

The World Employment Conference sponsored by the International Labor Organization (ILO) in 1976 set out to consider the mechanism by which the developing countries could satisfy their basic needs for essential goods and services. The report to the Conference analyzed the policy measures that would be necessary for the family and the community to obtain adequate food, shelter, public transport as well as health and education facilities. The main instrument to achieve these aims, according to the report, is to create "adequate employment" defined as "more remunerative and higher productivity employment." The precise manner in which women could participate in the formulation and implementation of the basic needs strategy, however, was omitted from macro-discussions. But the report recognized the contribution of women in providing the essentials of life, and briefly deliberated on the significance of full utilization of women's labor in an economy.

### Redefining Women's Work

If the official definition of labor force were to be employed using conventional economic indicators, a world profile of women reveals one-half of the world population and one-third of the official labor force. On the other hand, if a total range of women's actual

The author is an Indian social scientist.

economic activities were to be taken into account, a different picture of social reality would begin to emerge. For example, using simplified assumptions Table 1 presents the world distribution of work-hours giving estimated totals by sex and by market and non-market activities.

TABLE 1: WORLD DISTRIBUTION OF WORK-HOURS BY SEX AND COVERAGE  
 IN THE LABOR FORCE  
 (Percentage Distribution)

	Market	Non-Market	Total
<b>Included in labor force</b>			
Male	66	10	44
Female	34	28	32
<b>Not included in labor force</b>			
Male	--	--	--
Female	--	62	24
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: ILO, Womanpower (Geneva, 1975). The estimates give only order of magnitudes for illustrative purposes.

Table 1 illustrates what has been found in time budget studies and common sense observations in current literature on the work of women: that across geographical regions, women work longer hours than men in market and non-market activities--in industrialized countries and the urban sector of developing countries, and more obviously in the rural areas of Asia, Africa and Latin America. It is the nature and type of their work and the global performance of work-hours which raise fundamental economic and social issues. These issues are related to the stage of technological development of an economy as well as the existing division of labor between men and women in society.

#### Access to Scientific and Technological Knowledge

During the last decade there has been a veritable educational explosion in the developing countries. While literacy remains a formidable barrier to improving the status of women in developing countries, it should be noted that there is an increasing number of girls enrolling in schools everywhere. At the same time, more girls continue to drop out of schools than boys at all levels. The important point, however, is that even where girls manage to cross the first hurdles of primary, secondary and higher level school, their access to scientific and technical jobs encounters intangible barriers. In fact, several studies have emphasized that there is an inherent bias in the existing education structure of many countries (including developed countries) which pre-selects women into Arts and Humanities and away from scientific and technological subjects.

An ILO report pointed out that in most developing countries few girls are enrolled in technical and vocational education (those who are enrolled learn sewing, dressmaking, housecrafts, child-care and embroidery), and few girls are to be found in vocational training outside the school system. "There is sometimes a failure to distinguish clearly between home economics and vocational training outside the school system...although measures are now being taken to bring girls into agricultural schools, colleges and into extension work and services. Some governments (e.g. Egypt, Lebanon, Chile) are making special efforts to encourage the training of girls for some modern occupations such as laboratory technicians and industrial designers and to encourage their subsequent employment."

The principle is generally conceded that women and men should have the right on the same terms to receive education and training for highly qualified jobs and should enjoy equality of opportunity and treatment for career advancement. However, international data (scanty though it is) indicates that, with the exception of some of the Eastern European countries and the USSR, the proportion of women in most countries in "scientific professions" is low. Within these professions women are employed in research rather than in production and management, in specialist and advisory posts rather than in positions of authority, and in the public rather than the private sector.

Outside the formal schooling system and in the agricultural extension programs, projects and training schemes, the inequalities of access of women to learning continue. On this point, the existing information is unequivocal. As Ester Boserup and C. Liljencrantz noted, "In nearly all countries, agricultural training at low, middle and high levels is given to men only. This produces exclusively male instructors--instructors who, in turn, address themselves to the male farmers, overlooking women, even in cases where the wives, daughters and hired female labor are doing the work." The reasons for this neglect seem to lie in attitudes and beliefs that agriculture with female labor is backward, and that female labor should, if possible, be replaced by male labor when agriculture is "modernized." Where women account for a large share of the labor force in agriculture, the failure to teach modern farming methods to women results in adverse effects on agricultural productivity and rural incomes.

#### Impact of Technological Change on Women's Employment

Since the choice of technologies in developing countries became a subject of debate, a few recent studies, particularly in Africa, have focused on rural activities of women and their relationship to basic technologies. The conclusion of these studies concern three basic issues.

1. Mechanization in agriculture. Several papers from developing countries have pointed out that mechanization in agriculture is found mainly in men's work, while women's work both on and off the farm (including household tasks) has remained predominantly manual. It would appear that certain technological choices are not only labor-specific in that they might use or dispense with units of labor, but that they were female-labor-specific in that they absorb male labor and at the same time disemploy female labor.

This generalization appears to apply to many agricultural tasks such as weeding, harvesting and carrying operations, to food processing, and to a wide range of non-farm activities. For example, women's jobs and incomes from home-brewed traditional beer in some African countries are threatened by the introduction of large-scale breweries; in Indonesia, following the introduction of rice mills in Java, 7 million work-hours of women were lost, depriving them of a significant source of income (see p. 99). Similarly, in a study in Jammu and Kashmir (India) it was shown that with the introduction of machines to spin yarns, the livelihood of 20,000 women was seriously affected.

2. Division of labor. While the relationships of women to production and distribution in the traditional sectors remain significant and relevant, they seem to have limited access to modern technological inputs at all levels. Thus the output of their productive labor has either remained constant or has decreased, in contrast to that of men who have access to modern methods. The direct result of this unequal access between men and women is that work input of women increases proportionately in various agricultural tasks without giving them any control of their output. What emerges from this situation in many countries is that women work longer hours in almost all rural activities with the aid of only their muscle power. Table 2 provides a breakdown of activity between men and women in percentage of total work-hours in rural Africa.

The unequal division of the burden of daily work appears to be a common feature not only of the African continent but also of Asia and Latin America. For example, a comparative study of Nepal and Indonesia (1972-1973) by Devaki Jain points to the same conclusion: in rural areas of both countries women work longer hours (the differentials vary from 6 to 16 additional hours) than men in all age groups. In many societies, age over youth and male over female predominate in taking decisions on distribution of work. What appears to be a general feature of developing countries is that unequal division of labor on the farm is further reinforced by unequal division of labor inside the household.

3. Basic technologies. After devoting attention to the energy-consuming and frequently under-productive work of women in producing

TABLE 2: DIVISION OF LABOR BETWEEN MEN AND WOMEN: RURAL AFRICA

(percentage of total labor in hours)

Activity	Men	Women
Cuts down the forest: stakes out the fields	95	5
Turns the soil	70	30
Plants the seeds and cuttings	50	50
Hoes and weeds	30	70
Harvests	40	60
Transports crops home from the fields	20	80
Stores the crops	20	80
Processes the food crops	10	90
Brewing	10	90
Markets the excess (including transport to market)	40	60
Trims the tree crops	90	10
Carries the water and fuel	10	90
Cares for the domestic animals and cleans the stables	50	50
Hunts	90	10
Feeds and cares for the young, the men and the aged	5	95

Source: ILO, "A Research Note, Technology and Rural Women," p. 2.

and processing staple foods, hoeing and weeding, in providing fuel and water, a large number of studies have come forward to propose technological solutions. It has been suggested that there are considerable advantages in selecting and maintaining simpler devices and equipment for the use of rural women. Several new tools and devices have been minutely examined and tested and these include thin-walled cement tanks, simple hand-pumps, mud-brick stoves and simply better containers for food. Furthermore, harnessing solar energy, wind power and biogas rather than commercial sources of energy has been considered more desirable in the rural areas of developing countries. The essence of this sequence of thought is that rural women have been simply bypassed by the whole process of industrialization of which modern and imported technologies are an important part.

It has been argued that the introduction of such "basic needs technologies" would rule out *ipso facto* the products produced by imported technologies, raise the incomes of the rural women and the productivity of the resources employed, and simultaneously increase the quantity of resources at their disposal. By adopting the solution involving the use of basic technologies, it has been stated that rural women will not

only increase their productive capacity but could be helped to help themselves to produce goods and services for minimum needs.

#### The Modern Sector

Turning to the modern sector, the profile of women workers does not change fundamentally. There too, the introduction of mechanization has produced somewhat similar results. Studies and reports written a decade ago and those published recently point in the same direction: technological progress has the dual effect of widening women's employment opportunities and at the same time pushing them into less skilled and less mechanized occupations. This was recognized by the ILO Panel of Consultants on the Problem of Women Workers as early as 1957. That Panel underlined the positive features of technological developments which reduced the physical effort in a great many jobs, but also noted that wherever employment opportunities for all workers were in short supply, women workers were more likely to suffer the adverse consequences in the transitional period.

In 1967 when, at the request of the UN Commission on the Status of Women, the ILO undertook a preliminary survey to analyze the impact of scientific and technological progress on the employment and conditions of work of women in selected industries, the conclusions were again similar. The analysis of various industries such as metal trades, textiles, clothing, leather and footwear, food and drink and printing and allied trades indicated that there is a consistent pattern in the employment of women. A common thread that runs through each of the industries concerned the introduction of new machinery or equipment: it tended to displace women workers from previously held jobs to low productivity and low wage occupations. To take an example from the textile industry, which is a very large employer of women in many countries, an ILO report found that when a new machine is installed, the tendency on the whole was to "substitute male workers for women workers and to keep women workers on the older and non-automatic machinery." More recent investigation confirms this view. It appears that even in newer industries such as electronics, also a large employer of women in several countries including Norway and Singapore, the dynamics of technical change continually displace women into low-skill occupations.

Based on comparative analysis of many countries on the employment of women in postal and telecommunication services, an ILO report states that rationalization measures made possible by the introduction of new technical equipment often entail the abolition of temporary or part-time posts. Automation in telecommunications does away with operators' jobs; computers eliminate much clerical or bookkeeping work. "Such posts are frequently occupied by women; it is the female staff who are the most affected by the adoption of new techniques... ."

While there is no empirical evidence on measuring the actual technological gap between men and women's jobs, it appears that through various stages of the introduction of advanced or sophisticated technology, the wage differential (between men and women) also widens proportionately. Various reasons have been put forward for this phenomenon. Women workers generally have skill qualifications lower than men, from which it is concluded that women are not able to carry out highly complex and technical tasks. In a reply to a UN questionnaire, it was suggested that women are not in a position to take up work in the heavy industries "involving changes in science and technology, as they are not as yet physically and psychologically equipped for such work...mainly because of the lack of facilities for scientific training and research. But being deprived of such additional technological knowledge equally results in widening the skill and wage gap between men and women."

#### Future Directions

Three sets of problems have been alluded to above. First, the unequal access of women to the formal education and training, especially in scientific and technical skills in the modern sector, reinforced by the omission to incorporate women in agricultural training programs and projects. Second, some evidence has been examined from the multi-dimensional activities of rural women, especially in food production, which indicates that women continue to "manage" the subsistence economy with traditional techniques (new technology frequently aiding men's work). Finally, it has been shown from examples of some industries--modern and traditional--that the introduction of new techniques, in a shifting occupational hierarchy, continues to displace women or shift them toward lower skill, lower productivity jobs. This process deprives them of the opportunities of upgrading their skills and acquiring technological know-how. The most significant feature that emerges from the above discussion is the profile of inequality of women workers in relation to technical training, inputs and know-how.

Technology plays a decisive role in the process of development. Discussion of technology issues at the international level has been an area of controversy and there are different approaches and solutions. At the national level, the majority of developing countries continue to make technological choices and take decisions which seriously affect their internal division of labor between males and females. Both in the transfer from abroad and the development of national "technological capabilities" to take national decisions in the national interest, there are "external and internal constraints" on the transfer, choice and utilization of technologies.

Turning to the national interest, there appear to be other internalized constraints which play a decisive role in the existing division of labor within an economy and within the household. These are related to modes of production and models of industrialization. These "obstacles"--complex packages of economic and social factors--seem to create and perpetuate "technological dependence" of women in relation to scientific initiative. The cost in untapped human resources to the economy and society may well adversely affect productivity and employment. Some of the current problems in processes of development may have some direct relation to the fact that inadequate attention has been paid to the role of women in technology.

[Edited extract from Economic and Political Weekly, Vol. XIV, No. 36, September 8, 1979, pp. 1549-1553, Bombay, India.]

## Appropriate Technology for Rural African Women

Marilyn Carr

[Women in Africa perform mundane and oftentimes back-breaking tasks that could be made much more productive and easier through the adoption of intermediate technology. The following article discusses some of the more promising technological possibilities along with the drawbacks and problems of adaptation, acceptance, and sociological effects.]

### The Work of Rural African Women

A myriad of tasks. If intermediate technology holds out the promise of a release from unproductive back-breaking labor, of increased agricultural yields and a slowing in the rate of rural-urban migration, then there can be little doubt that those who stand to gain most from such changes are the rural women, who are the drawers of water, the hewers of wood, the food producers and often the overall providers for the families of Africa. In most of rural Africa, the women do most of the seeding and harvesting and sometimes do the clearing, preparation of the fields and planting. They fetch water, at some seasons 2 or 3 times daily, and may walk 2 kilometers or more each way. They collect and carry wood home. In addition, they look after children and old people, clean, wash, cook and preserve food for the family, and frequently help with the storing and marketing of the produce on the farm. In all, these tasks can amount to as much as 16 hours a day at some times of the year. Despite this, they are still often obliged to find at least some time during the day to spend on soap making or some other activity which can supplement their income in order to pay school fees or purchase items such as sugar and salt. They may also participate fully in community projects: in Lesotho, for

Ms. Carr is an economist with the Intermediate Technology Development Group, London, England, recently with the U.N. Economic Commission for Africa.

example, women are estimated to build ninety percent of the roads, and in Kenya they are responsible for about eighty percent of all "self-help" labor.

Evidence shows that in many areas life for the rural woman has been getting harder over recent years. Worsening drought conditions in many African countries mean that women have to walk greater distances to collect water; in Ethiopia, the women spent 3 hours or more on a single journey to collect water in 75 percent of the households under survey. In a number of countries, the land area under forest or woodland savanna has fallen drastically during the last two decades as more and more trees have been cut without being replaced. This means that the women have to walk further and further distances to collect firewood. As soil on rainfed fields becomes depleted through overuse, women have to cultivate larger areas of land to produce enough food to keep their families at subsistence level.

In addition, as the rate of rural-urban migration increases with the possibilities of high wages and modern amenities in the cities, rural women are often faced with the added burden of having to manage and operate their entire farm and household without any help at all from their husbands or eldest children who have left the women behind in their move to town. The 1969 Kenya census indicated that one third of rural households are headed by women; estimates for Lesotho are even higher. A survey in Mali showed that 16 percent of families depend solely on a woman, and a study among Yoruba families in Nigeria showed that one fifth of women received no support from their husbands.

In situations where women are having to spend more and more time in performing their traditional tasks and are also given additional tasks as their men are drawn away into the modern sector in the towns, it is not surprising that agricultural productivity in the subsistence sector declines. The women also have less time left to engage in supplementary income-generating and self-help activities, so family members left in the rural areas have fewer consumer goods.

The forgotten workers. The main problem in all of this is that the economic contribution of the women to the household, the community and the nation as a whole is always undervalued and quite often overlooked altogether. For example, the delivery of water and fuel to the house (whether by pipes, van or cart) is a service which has to be paid for in the towns. It is also a service which obeys the normal laws of supply and demand and becomes more expensive if the commodity becomes scarcer, greater distances have to be travelled to collect it, and more time spent in acquiring it. For instance, the increasing shortage of firewood in the Sahelian Zone has caused prices to rise to such an extent that many families in towns and cities such as Niamey, Niger, spend up to 20 percent of their income on wood. A com-

mon saying in this part of Africa is that "Il coutre aussi cher de chauffeur la marmite que la remplir." (It costs as much to heat the pot as to fill it.)

Thus, when put in terms of cost, labor has its value; and where a worsening situation can be easily defined in terms of cost it becomes a subject of immediate concern. In the rural areas, however, it is the women who perform the service of bringing water and fuel to the home. There is no question of payment involved in this. In fact, it is not usually even regarded as "work," but just a part of the women's household tasks. When water and fuel become scarcer, as they have been doing in many African countries, the women have to walk further distances and spend more time on these activities. But just as the original burden was overlooked, so is the additional one.

Water and fuel collection, as well as agricultural work done by family members, is not recorded as "work" by statisticians; and when statistics do not show women working, planners do not plan for women to work. But most families in the rural areas would starve to death if the women did not work for much of the day in the fields to grow the food to feed them. It seems inconceivable that a contribution of this nature could be overlooked, and yet this has happened. The modern tools and techniques, the fertilizers and the credit have been steered predominantly into plantation agriculture or large irrigation schemes, while the small farmers who are predominantly women have been left to struggle without the new techniques and training which are needed to raise yields. And when attempts have been made to increase productivity in the subsistence sector, stereotyped ideas about the sex of the farmer have interfered with positive results. In 1974, for instance, Liberia decided to try to encourage wet-rice cultivation and brought to the country a team of Taiwanese farmers. To assure attendance at the demonstration planting, the government offered wages to the observers. Many unemployed men participated in the experiment, while the women continued their work in the fields.

Failure to study the division of labor between the sexes can also have far-reaching effects in the "modern" agricultural sector. Cash crops usually become the responsibility of the men when the element of money has been introduced, but it is often the women who do most of the work on these farms. Thus, in one West African country, although extension workers had shown the men the correct depth to dig holes for the plants, coffee continued to die due to bent tap-roots because it was the women who were doing the digging. The same sort of thing happens when it comes to the weeding, harvesting, storing and processing of crops. Again, these tedious and time consuming tasks, which are almost totally the responsibility of the women, are considered as household duties rather than "work." When tractors or improved animal-drawn equipment are introduced, the men usually take over the task of land

preparation from the women. One wonders, however, how much thought was given to who would weed and harvest the extra acreages of land and thresh and winnow the extra yields, and to how this would be done. Very little progress has been made in introducing equipment to allow these tasks to be performed more quickly and efficiently.

When new improved technologies to help with these tasks have been developed, it is usually men who have planned and introduced them without understanding the likely impact of the innovation. The following kinds of things can happen as a result. Schemes to introduce hand-operated weeder have failed, for example, because for these to be efficient crops must be planted in straight rows. However, it is the men who have been taught this technique, while it is usually the women who do the actual planting. Schemes to introduce scythes to speed up the harvesting of crops have also had problems. Women traditionally perform this task using a small pen-knife to cut each stalk of the crop one by one. The scythes cut further down the stalk, and this involves a much heavier load to be carried from the farm to the home. Plans to introduce scythes would have more success if the trouble was taken to find out what implications are involved, and whether a re-design of the implement or complementary measures such as introducing transport facilities might be feasible. In the meantime, the women have not been consulted, and they refuse to accept and use scythes.

Similar examples can be found with new technologies developed to help with tasks such as the grinding of cereals and shelling of maize. Pedal-operated grinding machines and hand-held maize shellers may be appropriate in terms of low cost, ease of maintenance and repair and use of local materials. They may not, however, be at all appropriate in terms of the needs of the people who traditionally perform the tasks for which they are supposed to substitute. In many African societies, it is considered improper for a woman to sit astride, and where this is the case, women will not use a pedal-drive grinding mill, however useful it might be to them. Of course, men may take over the operation of such a mill, but under the circumstances hand-operated grinding mills which the women could operate would seem more appropriate.

An innovation with a somewhat different handicap is that of the hand-held maize sheller. Several types of these have been designed--all by men who, unlike rural African women, have not spent even a day shelling maize with their bare hands. Since women find they can shell the maize much more quickly with their own hands than with a sheller they see no point in buying one of these, even at a low (subsidized) cost, so the money and time which went into the development and production of such devices is wasted.

One area in which women greatly need help is in the use of new water technologies (i.e. the installation of wells, pipes, and pumps --as needed) to ease the burden of the daily carrying of water for drinking, cooking, and washing. Women also need to be given training in maintenance and repair of pumps and water systems. At present, if training is given at all it is given to men, who may see no great urgency in looking after water supply equipment when women are always available to collect water from further afield if the pump or piping system breaks down. This might explain why so many of the pumps installed in Third World villages are now out of order.

Women also need help in measures which can relieve them of the burden of walking long distances each day in search of firewood. Re-forestation programs might have more success if they were aimed at women rather than men. It may make little difference to the men whether the source of cooking fuel is 3 meters or 3 miles away. Similarly, attempts to gain acceptance of the use of solar energy and methane gas for cooking might have more success if the trouble was taken to explain such technologies to the women as well as the men. Food production, storage and processing are also areas in which women need help. A range of improved technologies is available for performing all these tasks more efficiently, but a variety of obstacles often stand between these and the rural women.

If women had access to equipment to help with the shelling of maize and groundnuts, the grinding of cereals and the pressing of oil from palm fruits, they could perform these tasks more quickly, with less effort and more efficiently. Usually, however, they have no money and no access to credit, and cannot purchase such equipment themselves; oil-presses in West Africa, and corn and rice mills throughout Africa are nearly always owned and operated by men. With access to such labor saving devices and with training in their use, women would have more time to spend on income-generating activities. Here too, however, a change of emphasis is needed. When training is available to women, it is usually in the supposedly "female" areas of sewing and cooking. Training in improved methods of making pottery, bricks and household and farm utensils is nearly always restricted to men, even though these are areas in which rural women are traditionally engaged. The introduction of labor-saving equipment would also give women more time to spend on improving their homes and participating in self-help activities. The combination of labor saving devices and a diversion of time into profitable income-generating activities could also give the women more money to spend on these activities --and extra money to spend on more labor-saving devices and equipment to help with expansion of small-scale businesses. This process can be seen as self-reinforcing, resulting in a vast improvement in living conditions in the rural areas.

While the fact that women perform most of the work in the rural areas continues to be ignored, there will be little headway made in increasing food yields and generally improving the quality of life in rural areas. The burden of this falls mainly on the women, and they cannot and should not be expected to make progress without the benefit of access to better equipment, training and credit facilities. The needs of the women and the community as a whole would be better met if women were given the means to purchase their own equipment on a cooperative basis, and if they were also taught how to operate and maintain the equipment themselves. The dissemination of appropriate technologies to rural women, combined with the fostering of rural industries to provide non-farm employment for both men and women, could go a long way towards improving employment opportunities in the cities of Africa. Some examples of technology that could contribute in this way are described below.

#### How Appropriate Technology Can Help Women

African women, when consulted in training workshops, conferences and meetings, have identified four areas in which appropriate technologies could make an especially significant difference in the lives of the rural women:

- (a) Provision of water supplies in rural areas;
- (b) Introduction of light transport facilities for the portage of water, wood, farm produce and other loads;
- (c) Adoption of efficient agricultural tools; and
- (d) Introduction of grinding mills and other crop processing equipment.

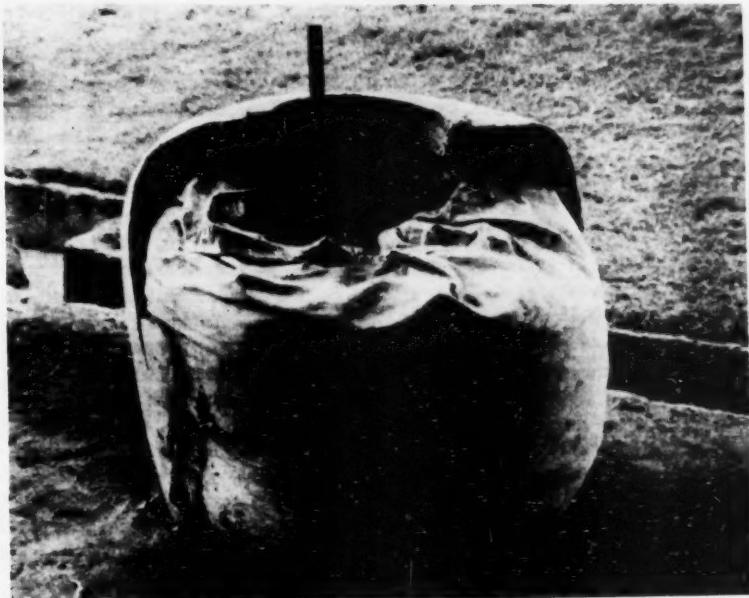
Water supplies. There is little doubt that the carrying of water imposes the most strenuous physical burden of all the tasks performed by African women. It is estimated that, on the average, one sixth of all the energy expended by the women in the rural areas is used in carrying water. Individual studies show that in many areas, women may spend as long as four hours or more on a single journey to collect water.

One answer to this problem is to provide a catchment for rain water nearer to the house. Catchment from roofs is possible and, even in areas of fairly low rainfall, it is a practical proposition. There is, of course, a problem of cost. Contrary to popular belief, it is not essential to invest in a galvanized tin roof for the purpose of water collection--a thatched roof covered with polythene can serve just as well. It is also possible to use local materials like bamboo to construct guttering. The real cost problem occurs with the storage of the water

once it has been collected. Conventional storage containers, usually made out of metal, are beyond the means of the average family or small village. Work is being done, however, on the development of cheaper storage containers. One of the more promising technologies is a thin-walled cement jar which was originally developed in Thailand and which is now in use in almost every household in that country. The cost of the cement used in making a jar with a capacity of 3000 litres is about US \$10; by comparison, the conventional galvanized iron container of the same size costs US \$100. This new technology has now been introduced in Africa through the Village Technology Unit in Kenya and is already gaining popularity in the rural areas because it is easy to construct, it is low in cost, and it meets a well-recognized need.

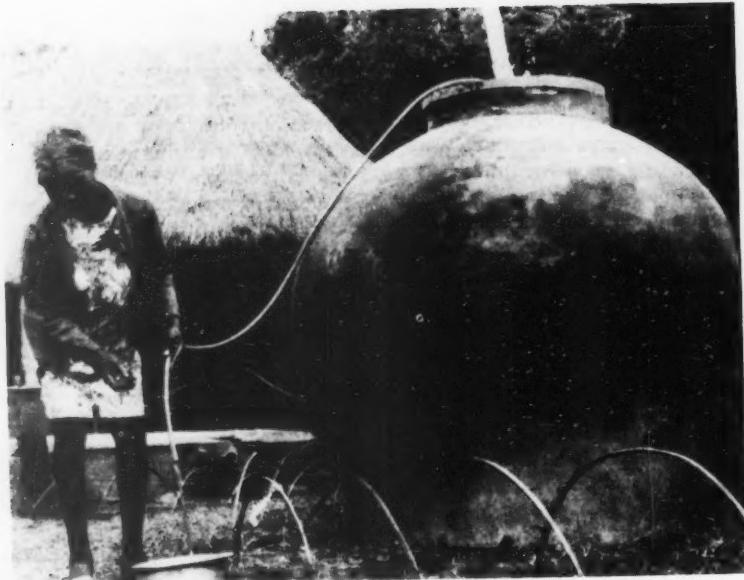
Water Storage

*Thin wall cement jars can be built very cheaply on a mold made from a stuffed bag.*



In many parts of Africa there are streams providing an ample supply of water in the valleys but villages are located in the hills, high above the water sources, so that the women have the back-breaking task of climbing up and down difficult terrain to collect water. This problem can be overcome with a hydraulic ram pump, which needs only the pressure of the stream flowing through it to lift water through a piping

These can be used for storing rainwater collected from roofs.



system to a higher elevation. Commercially made pumps are, of course, expensive. Prices range from US \$300 to US \$2,600 depending on pumping capacity. However, advances have been made in developing an adequate pump which can be made locally in areas where iron and pipe fittings are available at a fraction of the cost of the commercial imported varieties. Such a pump was constructed at the Village Technology Unit in Nairobi and has been operating successfully for the last two years, showing no noticeable difference in performance from the commercial pump which stands next to it. The pump requires a steady reliable supply of water with a flow of more than 5 liters per minute at the source; from a one meter head, it can pump water to a height of about 150 meters. It has only two moving parts (the valves), which are cheap and easy to maintain, and once installed it has no running costs.

There is a whole variety of types of water-lifting devices other than the ram pump which are either hand-operated or use the wind or some other no-cost energy source instead of expensive and scarce fuel. Besides saving the energy of women involved in lifting water out of wells with buckets, the use of a pump also allows the well to be covered and thus keeps drinking water free from surface pollution. Many of the hand-operated pumps cost between US \$20 and US \$70 and are within the financial means of a small community. An effective windmill for

pumping is likely to cost between US \$70 and US \$500 and is therefore, better suited to a larger community.

Transport facilities. Perhaps the most common sight in Africa is that of women carrying loads of water, firewood or other burdens on their heads or backs. The medical consequences of a lifetime of this activity have yet to be adequately recorded, but anyone who cares to ask can learn that this is a burden that the rural woman is anxious to shed.

This is far from being an easy problem to solve. The most probable alternative to carrying water or wood on the head or back is to push it on a wheelbarrow or handcart. With this in mind, several types of low-cost carts have been developed in Kenya, Tanzania, Zambia and other African countries. One example is the simple water cart developed in Machakos District in Kenya. Another is the inexpensive wooden wheelbarrow made at the Tanzanian Agricultural Machinery Testing Unit (TAMTU) in Arusha. In certain cases, these can help women by allowing them to carry more wood or water on each journey and thus fewer journeys are needed with less effort.

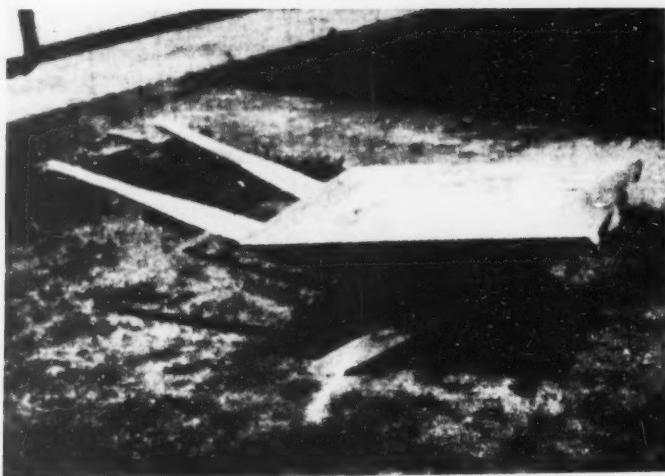
Often, however, women find the use of carts or wheelbarrows even more strenuous than carrying the load in the traditional manner since their muscles are unused to the physical strain of pushing. In any case, the terrain over which they must carry their load may be too rugged to allow the use of simple wheeled equipment. The obvious solution, therefore, is to bring water and fuel nearer to the homestead, rather than helping the women to carry these over long distances. The new water technologies which can help women in this respect have already been discussed. Similar developments are taking place with respect to fuel. Planting village woodlots is a feasible solution in some areas. In others, the best way out is to reduce the amounts of fuel needed.

#### Transport Facilities

*The Machakos Water Cart from Kenya (right)*



The TAMTU Wheelbarrow  
from Tanzania (below)



Fuel conservation. One popular approach to eliminating the need for firewood for cooking is the introduction of the use of solar heat for this purpose. To date, two types of cooker have been developed which use solar heat. One reflects the heat of the sun onto the bottom of a pot. The other uses the heat of the sun to boil water to produce steam which is then used for cooking.

The solar reflecter cooker works on the principle of using several reflecting surfaces to concentrate light and heat onto one point, the cooking point. Using only the sun's heat, two pints of water can be boiled in half an hour. However, this cooker must be placed facing directly into the sun and has to be constantly adjusted throughout the day as the sun moves. It can also be easily tipped over by children or goats; and only one small pot can be used for the cooking. Perhaps the most serious objection to these cookers is that the main meal of the day is usually cooked in the evening when the sun has gone to rest or lost most of its strength. The solar steam cooker is more expensive and more difficult to construct, but it can more easily be adapted to overcome the disadvantages of the reflective cooker. Since it is designed to use the sun's heat to produce steam for cooking slow-cooking foods such as maize and beans, it works all day in the sun (while the woman is in the fields) to produce a family-size cooked meal in the evening. The cooker does not have to be moved as the sun moves and it is much less likely to be upset or damaged.

Another approach which has been tried is the use of methane gas for cooking. In its simplest form, methane gas can be produced by filling one third of an oil drum with human, animal or vegetable wastes, one third with water and one third air. The drum is then sealed with a bacterial culture and fermentation takes place which produces gas. This is cheap enough, but problems arise in the storing of the gas and in the transfer to the stoves in which it is to be used. Cost-wise, it is more efficient to produce, store and use methane gas in large quantities. This indicates that village women might have to forego their individual kitchens and adjust to a communal cooking place in cases where the alternative of piping gas to each home would add too greatly to costs. Methane gas could perhaps be used in cooking communal meals in rural schools or day-care centers.

At the present time, one of the most feasible ways to reduce the collecting of firewood is to introduce stoves which use wood in a more efficient way. For instance, it is possible to use mud to build a stove on which three pots can be heated at one time and with only half the amount of firewood involved in cooking by the traditional "three stones" method.

Efficient agricultural tools. Most women in Africa till their rainfed fields with short handled hoes. If they had improved hoes, with longer handles, this would eliminate much of the hard work which is involved since less bending is needed. Planting and weeding are other operations which involve stooping and bending. In many areas of Africa, women must perform these arduous tasks, not only on their own land, but also on their husband's fields. There are, however, simple hand-operated seed planters and weeders, many of which can be made locally for under US \$20. One woman can plant about half an acre of land in a day with a seed-planter, and can weed up to 2 acres a day with a simple weeder.

Harvesting of crops, usually done completely or partially by women, is mainly accomplished by means of a small knife cutting the stems of the crop one by one. Scythes and sickles perform the job more efficiently, but these are often too heavy to be used by women, or are otherwise unsuited to their needs; they could be better adapted. There are also several types of small power reapers which can be and are easily used by women. These reapers consist of a small cutting blade which is operated off a very small diesel engine; the engine is carried on the back in knapsack fashion. One woman can harvest a whole acre in 25 to 30 hours using one of these devices (it takes days for an acre to be harvested in the traditional way). Developments have also been made in hand-operated, pedal-operated and animal-powered threshing and winnowing machines which take much of the effort out of these tasks and result in a considerable saving of time.

Grinding mills. Of all the tasks which rural women undertake daily, the one which is mentioned most frequently as being the chore they seek to be rid of is that of grinding maize, millet, sorghum, rice or other staple crops. It usually takes 1 to 2 hours to produce enough flour to provide an evening meal for the family, coming at the end of a long, exhausting working day.

One solution to this problem is a small community mill which is cheap, reasonably efficient in speed and fineness of flour, easy to operate and easy to maintain and repair. Several hand-operated grinding mills which can cope with an output of about 35 to 40 lbs. of flour per hour are currently available. Such mills enable a woman to grind enough flour for the week in about 30 minutes, and can easily meet the needs of small communities without being overused. The price of such mills--about US \$100 each--is also within the means of a small community. Developments are also taking place in pedal-operated and animal-powered grinding mills. In cases where maize does not need to be ground into flour but merely crushed, as in many parts of East Africa, there are also small hand-operated machines available to take the effort out of the operation.

There are many other simple, low-cost machines which can help women with processing of all types of crops. Hand-operated oil-presses can help with the extraction of oil palm fruit, coconuts, simsim, groundnuts and castor beans. There is also equipment available to take the hard work out of cracking palm nuts. A simple piece of equipment made from wood and chicken mesh can greatly cut down the time spent on decorticating groundnuts. Machines are also available to help with the shelling of maize, hulling and polishing of rice, crushing of sugar cane, grating of cassava and many other tasks in which rural women are constantly engaged.

[Edited extract from Chapters 2 and 3 of Appropriate Technologies for African Women, report published by the United Nations, 1978 (ECA/SDD/ATRCW/VTGEN/78).]

## Java, Indonesia: The Introduction of Rice Processing Technology

Melinda L. Cain

[This article summarizes some of the major social and economic impacts stemming from the Government of Indonesia's attempt to modernize agriculture. In particular, it examines the impact of several items of new technology on the traditional women rice harvesters and processors.]

Traditionally, Javanese rice farmers allowed anyone who wished to participate in their rice harvest to do so. The harvesters were mostly women from within the local village and from neighboring villages. The women used an *ani-ani* (small finger knife) for harvesting. The *ani-ani* was suitable for cutting local varieties that matured at different times and had varying stalk lengths because stalks were cut individually. The harvesters carried the rice in sheaves, bound in the field, on shoulder poles to the owner's house. This method of harvesting required large numbers of people, and many thousands of landless families were involved throughout the island of Java. In fact, one farm survey showed as many as 500 persons employed per hectare. The harvester's pay was a share of the crop he had cut, with a ratio of about seven to ten for the owner and one for each harvester. The division was made by bundles and not by weight.

### The Tebasan Harvesting System and the Use of Sickles and Scales

Traditional methods of rice harvesting in Java have changed significantly, partly because of the increased population pressures on land. Individual farm sizes have become smaller as farms have been subdivided from generation to generation, and it has become more difficult for

Ms. Cain is a research social scientist at the Office of International Programs, Denver Research Institute, University of Denver, Denver, Colorado.

farmers to run a profitable business. The population increase also has meant that a larger number of landless laborers are looking for harvesting work. As the amount received by each harvester has grown smaller, they have tried to obtain larger shares than custom dictates. Furthermore, since the farmers customarily have felt a social obligation to let all the harvesters participate, farmers have found their share of the harvest diminishing.

One way of improving the farmers' share has been to limit the number of harvesters. This can be done by the adoption of the *tebasan* system that enables the farmer to sell his crop to a middleman (*penebas*) before harvest. This makes it possible for farmers to limit the number of harvesters and avoid the problems of supervising the harvest and dividing the shares without failing in their social obligations as interpreted in the community.

Because the *penebas* is recognized as a trader, his right to a profit is accepted. Individual harvesters may benefit from this system, especially when the *penebas* can control the number of participants, thereby ensuring larger returns for each harvester. Based on village surveys, some rice always has been purchased by the *tebasan* method. However, the system has become more important with the use of HYV (high yielding varieties of rice), because there are now two harvesting seasons, and thus, more rice to harvest.

A comparison of costs of harvesting with the *penebas* were estimated from a sample of village surveys. Using the *ani-ani* rice knife and the traditional system, the estimated harvesting costs were about \$30.00 per hectare. Comparing those costs with about \$15.00 per hectare that it costs the *penebas* to harvest, it is evident that the harvest costs can be reduced about 50% by using the *tebasan* system.

*Tebasan* and the introduction of HYVs have caused an important technical change in the method of harvesting rice: the use of the sickle. While the *ani-ani* is more suitable for cutting traditional varieties of rice, as noted above, the sickle is preferable for cutting the more uniform HYV. When the sickle is used, the rice is threshed in the field, then carried in sacks to the *penebas*'s house, where harvesters are paid in cash according to the weight, not according to bundles; when the *penebas* began to use sickles, scales became necessary to weigh the shares for the harvesters. Harvesters must provide their own sickles, threshing mats, and sacks to carry the rice. With sickles, only about 75 person-days are required to harvest one hectare, while with the *ani-ani*, 200 or more person-days may be needed.

#### The Introduction of Rice Hullers

Mechanized rice hullers were introduced in 1970, due to governmental initiative, and their diffusion occurred very rapidly thereafter, as

illustrated by Table 1. By 1978, only about 10 percent of the harvest was being hand-pounded, mostly for family consumption.

Table 1. Number of Sample Farmers Processing Rice with Hullers, and Numbers of Hullers in Sample Villages, 1970 and 1973 (\*)

	No. of Farmers in Sample	No. of Farmers Processing Rice with Hullers		Number of Hullers in the Village	
		1970	1973	1970	1971
<b>West Java</b>					
Kab. Serang					
Sentul	27	0	0	0	0
Warungjaud	24	0	17	0	*
Kab. Cianjur					
Jati	29	15	29	3	5
Gekbrong	27	0	0	0	0
<b>Central Java</b>					
Kab. Banyumas					
Kebanggan	30	0	29	0	1
Sukaraja Lor	30	0	22	0	*
Kab. Kebumen					
Bulus Pesantren	30	0	27	0	*
Patemon	30	2	25	0	1
<b>East Java</b>					
Kab. Ngawi					
Geneng	29	0	26	0	3
Gemarang	30	n.a.	21	0	2
Kab. Jember					
Sukosari	30	0	26	0	8
Tanggulwetan	28	8	27	n.a.	8

\*Farmers from these villages used hullers in neighboring villages.

Source: Collier, "Choice of Technique in Rice Milling: A Comment." Bulletin of Indonesian Economic Studies, Vol. X(1), March 1974. Reprinted by permission.

A Japanese model of the rice huller that uses rubber rollers has been the most common in Indonesia. Rice must be processed through the machine four to eight times. It is first poured into the top of the huller; the hulls and (bran) excess material then travel through a pipe and are discarded outside the building. The hulled rice is then run through the polisher three or four times.

Choice of technology and economic aspects. C. Peter Timmer has analyzed the choice of the rice hulling technology in Indonesia. Four alternative milling/storage/drying facilities were considered by USAID/Jakarta and the Indonesian government in order to "modernize" the rice marketing sector, the most capital-intensive of which required \$65,000 investment per worker and the most labor-intensive required only \$700.

The Indonesian government chose the least capital-intensive mechanical technology alternative because it was economically preferable. Loans to buy hullers were made available at 1 percent per month interest, whereas regular village credit runs about 5 to 10 percent per month. Thus the machines were well subsidized, and available to those who could afford them. A study by William L. Collier estimates the average investment costs of a hulling center to be \$3,111 for machinery,

buildings, and land. Such a hulling center would have an average capacity of .58 tons per hour. This figure is based on the combined use of old and new equipment. Timmer estimates \$8,049 as the initial cost of a hulling center with a capacity of .42 tons per hour. [Note: price levels, exchange rates and interest rates have shifted over time.]

For a huller I investigated in Pasawahan, the initial cost in 1976 was Rp 2.5 million, about U.S. \$4,000. The owner of the huller said that operating costs were low. Both the huller and polisher were diesel-powered, using a crude kerosene fuel that cost Rp 30 per liter (five cents per liter, or twenty cents per gallon). Ten liters would run the huller for five hours and process about one ton of rice. Repair costs so far had been few; the owner pointed out a small part that had recently been replaced for Rp 40,000 (\$66). At this particular hulling center or mill, about two tons of rice could be hulled per day. This compared to the hand-pounding of forty kilograms per day by one woman. Two men who operated the huller and polisher could process about 100 kilograms of rice in twenty minutes and were paid Rp 45 for every 100 kilograms.

It was found in one survey of comparative costs that the average cost of hand-pounding was \$1.45 per 100 kilograms, while the average cost to the farmer of using a huller was \$.54 per 100 kilograms. The by-products of the huller were kept by the miller, while in the traditional harvest women were able to keep the by-products to use as animal feed.

Impact of the technology in Java. Since 1970 the mill has taken over work traditionally done by women. Two examples cited by Collier illustrate these changes: "A former rice trader, now turned mill owner, stated that he used to employ eight women to hand pound his rice. Four women working five hours could hand pound 100 kilograms; so this rice trader could buy 200 kilograms per day. The women's wages were 10 percent of the rice they provided, which amounted to just under two liters of milled rice per day. Over the harvest season these eight women earned perhaps sixty liters of milled rice each, or enough to feed themselves for four months. In Kendal, Central Java, a farmer said that in the past there were more than 100 women 'hand-pounder' laborers in his village. But now they have no work."

Estimates of jobs lost ranged as high as 1.2 million in Java alone as a result of the introduction of the new technology. Collier estimated that the loss to laborers in earnings due to the use of hullers was U.S. \$50 million annually in Java, representing 125 million woman days of labor. The rice farmer pays less to the mill for threshing and the process is much quicker, but the women have lost a highly remunerative source of income. The shift from a traditional technology to a more modern one has eliminated one of the more important sources of income for landless villagers.

Thus, although the adoption of the use of HYV, *tebasan*, sickles, scales, and rice hullers has served to increase rice production in Indonesia, it has not helped to solve the problems of unemployment and income distribution in Java. Rather, it appears these problems have been exacerbated. Furthermore, there is little evidence to indicate that the rural unemployed are being taken up by work opportunities in the cities, or have been able to find replacement sources of income in the rural areas.

#### Concluding Remarks

Indonesia is a land of contrasts. Java and Bali are islands with dense populations that create massive unemployment problems. Other islands are short of labor for production. While the observations made in this study refer specifically to Java, it is important to note the differences within Indonesia and to refrain from generalizing to other islands. This implies that regional variations within a country might well dictate the need for several different policy packages in technology choice within a single country, at least one with 140 million people on various islands. In this case, the policy for modernizing agriculture was applied throughout Indonesia, and as illustrated on Java, this caused some unanticipated negative impacts.

This case also shows, however, that technology by itself does not predetermine the outcome; it is the uses of technology that determine whether it has positive or negative effects. It is, therefore, important to consider who will own the technology and who will benefit from its use. On Java, those with a substantial income were able to afford the new technology. Those who were at the subsistence level, including the great majority of women who pounded rice, were not in a favorable position to purchase the hullers and thereby lost access to one source of income. In contrast, I was told that women in West Sumatra have used the introduction of rice hullers to their advantage. Due to the matriarchal system, women there own the land and make the agricultural decisions. They were able to form cooperative groups with sufficient access to financial resources to buy the hullers, and use them profitably.

Finally, this case describes a common trade-off in development situations: mechanization versus labor utilization. It is difficult to call rice mills a "mistake" because the process is more efficient in terms of input/output, and such efficiency serves the important national goal of increased rice production. Furthermore, hand-pounding of rice is an arduous task, and it is unlikely that the women were sad to see such hard work be replaced. However, if technology is to be introduced that may have implications for labor dis-

placement, a prudent policy consideration would be to provide alternative sources of income, employment and training for those who might be displaced. One way to deal with these consequences is to promote rural industry based on local materials; with some creativity, alternative sources of income can be found.

[Edited extract from Chapter 7 of  
Women and Technological Change in  
Developing Countries, edited by Roslyn  
Dauber and Melinda L. Cain, pp. 127-  
137. Published by Westview Press,  
Boulder, Colorado, 1981. Copyright©  
The American Association for the  
Advancement of Science.]

## New Technologies for Food-Related Activities: An Equity Strategy

Irene Tinker

[Women's contribution to the national economies of many Third World nations has largely been ignored in economic measures. The following article explores some of the reasons for lack of recognition of the "invisible woman" and discusses economic contributions made by women, in Africa, Asia and Latin America. The article focuses on food production.]

There are two biases in contemporary economic development thinking and practice which throw up psychological roadblocks to the inclusion of women as equal partners in development. The first is the continued emphasis on a dichotomy between the modern and the traditional sectors, between the economic activities done for money and those done within a family context, whether in a house, a farm or a handicraft enterprise, or as volunteer work. Statistics collected by many governments still tend to emphasize activities in the modern monetary economy; activities outside those boundaries may not be considered "productive work." The second bias, the stereotypes of appropriate roles for women which many men carry, interrelates with definitions of economic activity. Essentially, in this view, women don't "work," or if they do, they shouldn't.

These two unexamined biases have combined to skew development planning for the poor, men as well as women. This emphasis on statistics for the modern sector has obscured activities in the informal sector. For example, planners for Africa are given data which tell them that only 5 percent of the women work. It is too easy to forget that such a figure applies only to the modern sector and thus to obliterate, for planning purposes, the fact that 60 to 80 percent of the agricultural labor is done by

Ms. Tinker heads the Equity Policy Center, Washington, D.C.

women in Africa, or that women dominate the marketing and processing of agricultural produce.

Kathleen Newland in her 1979 book The Sisterhood of Man records how differently different countries define which activities are included in national income accounts. She describes the long work days of Iranian nomad women who, in addition to the care and feeding of the family,

"...haul water into the camp on their backs. They milk and shear the animals, mostly sheep and goats. They collect such edible plants, berries, roots and fungi as the surroundings afford. They churn butter, make cheese and yogurt, and refine the left-over whey into the daily beverage. They spin the wool and goat hair into thread or press it into felt and make clothes, tent cloths, and carpets for their families' use. From each tent-household of an extended family a woman goes daily to collect firewood from the brush; on the average, she spends half a day at the task, plus another hour at the camp breaking the torn-off branches of thorn-bush into pieces small enough for the cooking fire.

In the national economic accounts of Iran...the only portion of the nomad woman's work that will show up even as subsistence production is her output of woolen textiles and dairy products. If she lived in the Congo instead of Iran, the accountants would also include her food-processing activities in calculating the Gross Domestic Product, but they would omit her production of handcrafted articles. Taiwan's bookkeepers also would leave out handicrafts; they would, however, assign economic value to the woman's water carrying and wood gathering. But in Nigeria, it would be argued that, in rural areas, wood and water are free goods, like air, and so are the human efforts that make them useful." (pp. 129-30)

The inconsistencies involved in the coverage of income accounts are apparent in the United States today. With the rise of two-income families, nearly half of the food consumed in America is eaten outside the home, prepared by paid workers in restaurants. Suddenly the effort to feed the family has been moved from an invisible category to "economic activity." Many of the services to the sick and infirm which were formerly undertaken by compassionate relatives or volunteers, predominantly women, must now be paid for. Money is the measure of status; "non-productive" activities are seen as peripheral and marginal--until they begin to disappear.

Among the poor, every family member who is able must contribute to the family support. Such support becomes even more crucial as poor families are pushed to their margin. Ann Stoler has analyzed women's economic activities in Java in relationship to the family budget, and finds

that the women in landless and near landless families earn one-third of the household's total income, a much larger share than is contributed by wives from larger landholding classes. In Mexico, the contribution of women to their families' budgets varies by cultural groups as well as class.

Particularly in Africa, the persistence of sex segregation in both occupation and responsibilities means that in many areas a woman is expected to provide food, clothes, and education for her children and food for her husband from her own separate budget. As men's earnings have increased through cash crops or urban employment, they often feel no obligation to increase their share of child support. Recently a Kenyan woman sued her urban-dwelling husband in District Court for school fees for their son. His defense was that he had provided her with a piece of land; she was responsible for the care and schooling of the children. The judge, however, found for the woman, who had argued that the size of the land made it impossible for her to save enough money for fees; besides, this husband was well-employed.

Because African women provided the bulk of family support, modern industry and plantations were able to siphon off the men without paying them wages sufficient to provide for the entire family. A recent UN report notes that in Lesotho this "functional relationship between the subsistence and the modern sector provides 95 percent of the cash earned there. At any given time, close to 40 percent of the working-age male population resides in South Africa, thereby leaving the villages with a substantial numerical predominance of women. Since the men's earnings are not sufficient, the subsistence output provided by women is necessary for family survival.

The pressures on the family of such migration patterns have clearly contributed to the increased numbers of women-headed households around the world. Economic development which has left women behind in the subsistence economy while pushing men into the modern sectors encourages the disintegration of the family. Today it has been estimated between 25 and 33 percent of households are de facto headed by a woman due to divorce, death, desertion, long term migration, or because she never married. These female-headed households are among the poorest groups in every country. And poor women, whatever their living arrangement, must work to survive. Being invisible to development planners, and being the poorest of the poor, they have as a group been most adversely affected by development.

#### Women and the World Food Crisis

The three major strategies for meeting the world's food shortages--increased production, greater income-producing activities so people can buy food, and a reduction in postharvest food losses--should be strategies for aiding the rural poor women. Women in Asia and Africa provide between 60 and 80 percent of agricultural labor; in Latin America the average is

about 40 percent. Indeed, poor women everywhere work in the fields, though such labor may be denied because of the status implications. Women's participation in processing, preserving, and preparing food is even greater than their participation in production.

Women's responsibilities to help feed their families are becoming harder to fulfill as modernization restricts traditional activities which enabled women to grow or earn food. Greater income-producing activities for women could therefore have a more immediate impact in supplying basic food and health to the poor than similar activities aimed only at men. In order for the food crisis strategies to accomplish their goal of feeding the world, women must not only be included in planning, they must be central to it. Women must be consulted in the selection of new technologies, trained in their use, and given means to control those most related to their spheres of economic activity.

Almost universally, new technologies for food-chain activities have been introduced to men regardless of women's contributions. Rural poor women are more likely to be illiterate, and so presumed unable to alter custom to adopt new technologies. Further, rural credit is scarce enough, and is seldom extended to women because they lack assets for collateral. Land is the major rural asset, and colonial governments generally registered communal land in the man's name. Women's uncertain access to land, credit and education prevents their access to and control of new technologies which might help them out of the poverty, so that they could afford land, credit, and education. This vicious circle has intensified women's dependency on men in rural areas. Further, many of the technologies introduced into agricultural production have had negative effects on poor rural women by removing their opportunities to earn money in the activities where labor is saved.

The greatest impacts of technology in agricultural production have been on cash crops such as bananas, cotton, pineapples, rubber, tea, coffee, sugar cane, peanuts, and sisal. While many of these crops are edible, they are seldom part of the local diet. Cash crops have competed for land and labor with the local food crops. Until recently little research went into improving most food crops. As wheat, corn and rice became exchange commodities in the international market there have been concerted attempts to improve production. The resultant "green revolution" has affected rice and wheat; but other major subsistence crops such as yams and millet or beans and cassava have yet to respond to research efforts. Local market crops and small animal breeding have received little research attention, underscoring again the perceived dichotomy between the modern commercial sector and the traditional sector.

The impact of new technologies varies both by major crop and by farming systems. Ester Boserup in her landmark book on Women's Role in Economic Development finds a relationship between women's status and the need for her labor in subsistence food crops. Thus the introduction of the

plow contributed to a loss in women's status historically; similar impacts occurred with the introduction of the sickle in Indonesia, or new crops in the Sudan which lower women's utility and hence their status.

Sub-Saharan Africa. The change in women's status as a result of agricultural modernization can be seen most clearly in Africa. In the traditional societies, women held fairly independent and equitable positions in both the nomadic and settled agricultural communities. Such societies were also characterized by little social stratification. Women did the bulk of farming work among the settled agriculturists. The major impact of new technology, being focused on non-subsistence crops, has been to draw off land and labor from the food crops. Women continue to grow and control food crops, but because this sector has been much less monetized, they must seek money from other activities. The specifics of this impact vary, but some of the leading effects have been:

- men migrate to urban areas or to mines in search of income;
- women work cash crops in addition to subsistence crops;
- women's land is taken away for cash crops;
- new settlements ignore food needs and thus women's productive activities.

The culmination of these trends has been to increase the work of poor women while lowering their status. Women from the growing elite classes, however, have tended to move out of food production.

*Cash and subsistence crops.* As men migrate to cities, statistics suggest that one-third of farm managers in Africa south of the Sahara are now women, with even higher percentages in some countries: 54 percent in Tanzania and 41 percent in Ghana. Most cash crops in Africa are grown on small holdings. Many women not only work their subsistence crop fields but also contribute their labor to cash crops. This reinforces the inequity and inefficiency of the present practices, according to Louise Fortmann in her study of Tanzanian agriculture.

"The inefficiency arises from the fact that women...have limited access to...information and land which would allow them to become more productive. This differential access is based...on accepted social norms and customs. Similarly, the heavy work load already imposed on women often prevents them from adopting improved technology that requires additional labor inputs. Thus the present village and household organization of labor limits the potential for increasing production... Because of traditional rules of land tenure relatively few women are able to undertake cash crop production in their own right. Those who work on their husband's cash crops rarely receive a proportionate share of the proceeds." (Dar es Salaam, mimeo, 1978)

Where women get few rewards from the production of cash crops, it is no surprise that whenever there are competing demands between food and cash crops, they work on the food crops. In the Gambia, where women receive the full proceeds from the sale of onions they grow, over 4,000 willingly work on this cash crop.

*Plantations.* Plantations are less common in Africa than in Asia, but in both continents women have provided them with cheap labor. In Uganda and Kenya, however, this source of income is diminishing on coffee and tea plantations where the introduction of insecticides and fungicides have reduced the need for weeding, by as much as 85 percent in some cases. National governments, eager for foreign exchange, and most agricultural experts have tended to view the use of land for subsistence crops as inefficient. Pressures to grow the more profitable export crops have reduced acreage allotted to food crops, and in some areas have resulted in women losing their traditional rights to grow their crops on communal land. In Upper Volta, for example, a foreign development scheme for swamp rice essentially turned the crop over to men along with the land used for it. In Cameroon, women were forced off the cleared land near a village which is nearly all taken up with coffee and cocoa plantations; the food fields are anywhere from one to ten kilometers from the village.

*New settlements.* New settlement schemes have often had a deleterious effect on women. In Nigeria, the government provided families with five-hectare plots for the production of soybeans for sale. Corn could be grown for personal consumption, but amounts were limited by the seeds provided. No garden plots were provided, thus depriving women of land to grow food for the family which they had done, with the exception of corn, before joining the resettlement program. Income from the cash crops was given to the men while women received no wages for their labor on these fields.

The Mwea irrigated rice scheme in Kenya did allocate garden plots to the women, but these were small because it was assumed that rice from the irrigated plots would be added to the diet. Women in fact did receive some rice in return for their labor on their husbands' land, but since the men refused to eat rice, women had to sell it and buy traditional food at increasingly high prices. Women on the scheme did not have time, nor land, to raise enough food for their own consumption; they worked longer hours than before but could not provide as much food for their families as they had. In addition, they often had to buy firewood for cooking since fuel was scarce in the resettlement area, and women's time was less. Thus while the total income of the families in the scheme has gone up, and visible wealth in the form of transistor radios and bicycles is in evidence, nutritional levels nonetheless have fallen.

*Nutritional levels falling.* A recurring theme in these studies of new technology for cash crops is that while cash income may have increased, nutritional levels tend to fall. The primary reason for this seemingly contradictory phenomenon is that this increase in income belongs to the man. In parts of Africa, men may use this money for improving homes, or in throwing "prestige" feasts, or buying transistor radios, instead of for more pressing expenses to meet family needs which had not been their traditional responsibility.

A second major problem in ensuring that increased income is translated into improved nutrition is the marketing system. The fragmented nature of the present marketing system in Africa means that traditional subsistence crops are not widely available. Market crops cannot be shipped any great distance because of the spoilage problems and lack of transport, even when the earners of incomes from cash cropping could afford to buy them. As areas urbanize and markets include a greater variety of food, cash becomes more important, while in smaller markets it is still possible to barter.

*Projects which increase food supply.* Changes in agricultural technology have generally not worked in favor of African women. Subsistence crops and market crops have been ignored by researchers and extension workers, while cash crops and farm machinery were considered appropriate only for men. There are signs of change, however. An Integrated Farming Pilot Project in Botswana which was started in 1976 for male farmers to improve their dryland farming and livestock management techniques has since expanded its program to include 100 women. Week-long courses will stress vegetable gardening and poultry keeping. Further, agricultural extension agents will organize special field days to demonstrate new techniques to women. Scattered efforts have been made by Peace Corps volunteers to encourage women to raise bees, poultry, or rabbits, although there is little evidence that these new productive activities were incorporated into the local economy.

The Peace Corps efforts in introducing or improving fish culture in Africa may have a more lasting impact, particularly in northwest Cameroon. Since 1978 some of the volunteers for fish culture activities have been women. The current program in Zaire features the *tilapia*; fingerlings are introduced into shallow ponds which have been built with a plug so that water can be drained for easy harvesting. While men dig the ponds, women carry the agricultural and animal wastes on which the fish thrive. In six months there can be as much as a two hundred percent return.

*Income-producing projects.* One of the most successful African programs for income-producing is in gardening and pig production in Kenya. Its growth seemed almost spontaneous. While the government is now assisting in marketing, it had played very little role earlier. It is instructive that the women expanded their gardens and small animals once

they had time to do so. The *mabati* (the Swahili word for tin roof) movement in Kenya gave women time. Tin roofs enable rainwater to be saved and stored, releasing women from the daily chore of fetching water that takes two to ten hours per household. The women have used traditional rotating credit societies to accumulate cash to buy the tin roofs. Each woman puts so much money in a communal pot; each woman wins the pot with the turn drawn by lot. With the time saved by available rainwater, the women increased their production of vegetables, chickens, and pigs for sale in the urban markets.

Asia. Recently, studies have disaggregated the impact of the green revolution on women and men. In India the overall impact has been a reduction of employment opportunities for women, a trend reported in the Census of 1971. A study in Punjab, India, noted that while displaced men were given an opportunity to take the training necessary to operate new machinery, women were left to work in the increasingly scarce unskilled jobs. This "pauperization caused by the disappearance of their traditional avenues of employment" has pushed many poor women into the cities.

Poverty has made women's jobs on plantations attractive to many poor Indian families, both in India and in neighboring countries. On tea plantations in India and Sri Lanka, women make up over half the labor force; on Indian and Malaysian coffee estates, they make up 44 percent of the labor force, while their participation in rubber estates is only somewhat less. A major reason for this growing female labor force is the wage differentials between males and females: women are paid about 80 percent of male wages for the same work. As production costs rise there is greater incentive to utilize new labor-saving technologies and to increase the percentage of women in the labor force.

*Income-producing activities.* A major factor which encourages women to increase their economic activity in the monetized economy is the ability to keep control of their earnings. The success of the Korean Mother's Clubs is a case in point. Based on historic cooperation of women in supporting each other in providing expensive ritual festivals for marriage or death, the Mother's Clubs were set up to facilitate the distribution of birth control pills. Three-quarters of the Mother's Clubs organized Mother's Banks. Encouraged by financial resources of their own, women in many villages started projects to earn money with which to build schools, run stores, improve village services. While the groups have now branched out into a variety of income-producing activities, market production including gathering of nuts for sale was frequently the first income-producing activity.

Recent efforts to reach rural poor women in Bangladesh have been impeded by purdah restrictions (Islamic traditional feeling against women's activity outside the home). Nonetheless, women's cooperatives

are successfully marketing fish, bananas, limes, ducks and chickens, and vegetables. Operating solely with capital saved by the women themselves, these cooperatives are seen as models for the rest of the country. In Yemen, as men are drawn off to work in Saudi Arabia, women are taking over much of the farming. The recognition of women's economic activity is resisted the most in the more conservative Muslim areas. Status is attached to seclusion, except for a small Westernized elite; with the recent revolution in Iran, even that may be subject to change. Nonetheless, it is clear that poor women in all countries, including Islamic ones, must and do contribute to the survival of their families.

Latin America. Women in the agricultural labor force in Latin America, while proportionally fewer than those in Africa and Asia, make up a still impressive 40 percent, according to the Economic Commission for Latin America. This figure is understated, according to Carmen Diana Deere. In her survey of women doing agricultural work in Peru, Deere found that 86 percent of the women in peasant households participated in the agricultural work, as compared to the 38 percent figure in the 1976 Official Peasant Family Survey. Self perceptions are partly responsible; if a man resides at home, he is the farmer. "The majority of the women that considered themselves to be agriculturalists were female heads of households with no adult male present."

In Honduras, 13 percent of the rural households are permanently headed by women; the figure rises to 25-27 percent if seasonal migration is included. These women tend to be landless, and must seek wage employment on the cotton and coffee plantations. In the Peruvian highlands, the transition after land reform from the hacienda system to *minifundio* has relieved women of many servile tasks formerly required by the landlord. But it is difficult for a family to live off the small plots of land. As men are forced to seek wage income off the farm, the responsibilities of the women increase, increasing her self-esteem and status. As landlessness or near-landlessness increases, the poor farmers must increase their wage labor away from home. In Peru and Honduras men migrate seasonally from the mountains to work on large farms. In Northeastern Brazil, the farmers assist with the sugar harvest on the large plantations.

On the Latin American small farms, then, modernization has meant an increase in women's labor as the men frequently seek work elsewhere. In addition, manufactured goods in the market have undercut many local handicrafts previously made by women, making them more dependent on income from agricultural production.

To summarize: New technologies for agricultural production have been concentrated on cash crops and on selected basic grains. Generally the impact of these technologies has been to increase production, concentrate landholdings, and encourage social stratification. In Asia and

Latin America the wives of larger landholders have greatly reduced their involvement in the fields. There is often an accompanying loss of status: in India, a switch from bride price to dowry has occurred in some areas, as brides are no longer valued for their economic contributions. (Dowries are usual in the Middle East, while bride prices are found in much of Sub-Saharan Africa.) In Africa, well-off farm women tend to remain in the rural areas managing the farms, sometimes hiring other women to help with the harvest of cash crops.

Poor women in all the developing regions have had to work harder as a result of new production technologies which cause their husbands to seek work away from home. Women heads of households or wives of men who migrate to wage jobs elsewhere undertake both the traditional male and female agricultural activities. Families with only a garden plot or splintered field must send all adult family members to work as wage laborers. As new technologies reduce the need for unskilled laborers, a few men are trained for the semi-skilled jobs. Men left in the unskilled labor pool are perhaps worse off than the women; women's wages are less, and they are displacing men in plantation work. Women also have traditionally worked at a greater variety of unskilled jobs and in many countries are able to survive through market selling or handicrafts. Elsewhere, women have joined the urban migration, working for low wages in industries, or as domestics, or becoming prostitutes.

The garden plot where the poor women can grow food to enhance their family's nutrition and then sell the surplus emerges as an important factor in family survival. What is less well appreciated is the major contribution it could make to alleviation of world food shortages. Clearly, greater attention to garden crops and to marketing of fresh vegetables and fruits should be a priority in any planning for rural development. Similarly, attention to small animals and fish culture, both for subsistence and for sale, could add immeasurably to the welfare of the poor.

[Edited extract from Chapter 4 of Women and Technological Change in Developing Countries, edited by Roslyn Dauber and Melinda L. Cain, pp. 51-83. Boulder, Colorado: Westview Press, 1981. Copyright© the American Association for the Advancement of Science.]



## PRIVATE ENTERPRISE



## Private Enterprise and Development

Gordon Donald, Editor Development Digest

National economic development has a number of different aspects. Developmental progress is most commonly estimated as economic growth, which can be measured with exact numbers, but it includes a number of other things that cannot be so estimated. For example, development has a mental aspect: simply in order to produce more kinds of goods, it is necessary to understand production processes not known previously. Along with such knowledge, the attainment of a range of manual and mental skills is required. (Knowledge and skills are sometimes estimated by educational levels; but years of schooling is a very rough measure which could be misleading.) The capability not only to perform specific tasks but to take on a new task, master it and go on to another, to envisage new ideas and pursue them, to learn from experience and use the lessons well--such capabilities are as much a part of national development as the goods and services produced, perhaps even more at the heart of the process. To put it another way: development is not just what a nation has, in wealth or other respects; it is what its people do.

How does this emphasis on development as what one can do with whatever one has affect the analysis of developmental requirements? It cannot, of course, eliminate the need for physical and financial resources as ingredients of production. It does, however, suggest a lesser emphasis on the extent to which a nation's developmental fate is predetermined by its physical resource base. Some countries have done more than others with such resources, or--more pertinently--with their human resources; for example smaller states with a limited physical base like Singapore and Hong Kong have indeed done well. Similarly, the size of the inflow of financial resources, as measured in money, may not so precisely determine what can be done by a nation as is sometimes thought; again, some countries have done better than others per unit of inflow. It is useful for economists and planners to make estimates of future output and income based on measured inputs of resources; but it is not necessary to regard such mechanical estimates as laws of nature, as the only possible outcomes.

From the point of view just described, we may consider the role of private enterprise, as distinct from governmental activities, in furthering development. This is a current theme in the thinking of the U.S. government today; but the editorial views expressed here should not be read as representing official policy or positions. This is a personal statement.

In order to give credit to the potential role of private enterprise it is necessary to indicate a view of how governments work. It is normal to think of governments as stating national objectives, formulating policies, making decisions and obtaining the results which the decisions

are intended to accomplish. This probably exaggerates, not so much the power of government as a whole as the power of individuals in government to make things happen as they wish. In almost any government there are some opposing forces, groups with different ideas and interests contending with each other. Policy decisions may not be carried out as intended for a variety of reasons--internal opposition, inertia, inconsistencies, etc. However, they are generally presented to the world as "the Government's" action or opinion. Individuals and their roles--except for the formal leaders like ministers or head of state--tend to be submerged. This has the effect of making governments appear to be unified and concerned with national purposes.

In contrast, private businesses and production activities are conducted for the profit of owners and their associates, without pretense of higher social purposes. They serve their customers, of course, whether they be traders, farmers, craftsmen, or factory managers; and if they did not, they would lose money and eventually be eliminated (unless they possess a monopoly privilege). One may say, therefore, that they do serve society, providing goods and services that people need and want. They do this with varying degrees of satisfaction to others, and this ought to correspond to the extent that their business is patronized, and thus to their level of profit or reward. This correspondence may often be rather loose, perhaps even hard to detect at times--unworthy people may seem to prosper. Nevertheless there is a discipline at work: unless people are compelled in some way they will not buy what they don't want to buy; and without that, the income of the seller of unwanted services cannot materialize. Thus, it can be said that it is the very selfishness of the private entrepreneur which causes him to serve society.

These ideas are not new. In fact some would say that because some of them were first formulated by Adam Smith in the 18th century they are now outmoded, and for that reason alone are inferior to more "modern" socialist thinking. Others may feel that ideas originating in Western nations may be appropriate under Western conditions but do not meet the somewhat different needs of the conditions and cultures of today's developing countries. These subjects will be taken up below. But first it needs to be pointed out how people's unconscious assumptions are influenced by the situation described, where governments appear to be unified and concerned with social purposes because their spokesmen talk in this way, while private parties have no such voice and are assumed to be selfish, uncoordinated, and even hostile to social concerns affecting their pocketbooks.

This is an issue of moral consciousness, and also one of developmental efficiency. Moral traditions vary among nations and among the subcultures within nations, as well as shifting through time, so it is not universally true that commercial values are either looked down on or held in high esteem. But there does appear to be a tendency for certain occupational groups, at least, to despise private traders; civil servants in particular seem to do this in a variety of settings. This may take

the form of a feeling that traders make a profit by "exploiting" poor people, whether farmers or customers; it also commonly takes the form of an assumption that if something needs to be done it ought to be performed by government, which will do it properly, rather than by private parties who will serve their own improper ends.

This assumption has consequences for developmental efficiency. For example, farmers need more fertilizer, and a ministry will distrust the ability of a nondescript group of traders to get it to them cheaply and properly; so a state enterprise for fertilizer distribution is organized, and is given orders on how to perform its functions. Generally, this kind of enterprise is slow to move. It gets fertilizer to some farmers and not to others, often too late for optimum use; it fails to explore new farming areas unless pushed from above; and bribery is not unknown where fertilizer is in strong demand. Farmers may get cheap fertilizer if it is subsidized; but the costs of getting it to scattered rural areas are generally higher in state operations than in private ones. And the state enterprise is never punished for failures, or even made aware of them, but goes on getting its subsidy as needed.

Here is a simple and representative problem in efficiency and morality: would private traders do this job better? It cannot be guaranteed that the profit motive will drive traders into all the rural areas in search of business, but this seems more likely on the whole than the results of whatever it is that motivates bureaucrats to explore new activities (they are more reliable in performing established routines). Will the traders be more responsive than a state agency to special local needs, or to emergency shortages? This too seems probable. Will the traders charge farmers too high prices? This depends on two elements. First is the matter of competition: if fertilizer dealers can establish local monopolies, high prices can be expected, and price ceiling regulations would be hard to enforce; but if enough traders come to offer farmers a choice of suppliers, prices will come down. Secondly, the price at which fertilizer is made available to distributors (private or public) may or may not be subsidized for the benefit of farmers; there are different ways of doing this, with differing results. (The subsidy to state enterprises mixes up the subsidy on initial fertilizer prices with a subsidy for inefficient operation.) Finally, will traders be living at a high income level on their profits made from poor farmers? This question should be rephrased to ask whether the average (not the most prominent) rural trader is living at a higher level than the average state enterprise unit manager (including both his legal and irregular income); and whether the incomes in question have been justly earned by superior service to farmers. Such a question is rather complicated and requires specific knowledge to answer; it seems to me desirable to put the moral issue in this form.

The example of fertilizer distribution may be somewhat biased in the direction of activities which state enterprises usually do badly.

There are fields in which their performance is better--generally where large centralized operations are needed, rather than dispersed, exploratory or innovative actions. There are also situations in which private organizations could not in any case be formed on a sufficient scale, so there has to be a state enterprise or nothing. And of course there are a number of good as well as bad performers among state enterprises. It is noticeable that the most efficient tend to be those which are treated by their governments as if they were as independent as a private firm. When a government does not automatically subsidize the firm's deficits, does not insist on political appointments, does not overregulate its activities, or require certain favored customers or sources of supply, the level of the public firm's performance is likely to be higher--other things being equal.

This kind of thinking is not just the complacent view of those who are accustomed to capitalist economies, but it is emerging increasingly in Eastern Europe and China where private enterprise has been absent for many years (except in small-scale or illegal forms). In all of these countries there was an initial wave of industrial build-up, followed eventually by varying degrees of stagnation, and in time a questioning by some intellectuals on pragmatic grounds of the hitherto sacrosanct socialist doctrines. Hungary has gone furthest toward a return to the profit motive for socialist societies, and others including China are moving in that direction. In Western Europe too, where a wave of post-war interest in socialist methods led to the creation of various nationalized entities, there has been a reaction against state enterprises that kept on needing subsidy while failing to perform as desired. This is not, of course, a unanimous view in East or West, but an apparent general trend (France, for example, is moving against the trend). But it is interesting that some of the newer socialist thinking in Western Europe is turning toward worker self-management and worker ownership of enterprises, rather than the traditional etatism--i.e. government ownership and operation.

The reasons for this apparent trend toward a new appreciation of what the profit motive can do for society if allowed greater freedom of operation may not be quite those cited by Adam Smith to counter 18th century mercantilism, though they are not completely different. A key element is that of motivation: if socialism is conducive to stagnation, it is because rewards in a governmental type of hierarchy usually go to the cautious fellow who makes many friends and few disturbances, who "does not rock the boat." Adventurous spirits, proponents of new ideas, or even those who work extra hours on the job may be unpopular, and un-promoted. This tendency might also be noted in some private corporations, banks for example. But all the same, the man who goes out and brings in a new area of business, or finds a better way of running a machine or designing a product has more chance of reward in the private sector. And the cumulative impact of a number of small actions that bring small improvements can add up to significant national totals.

It does not automatically follow that developmental innovations will come about when a government merely sits back and lets them occur in the private sector, as might be claimed for the Western countries. Governments in developing countries must play a more activist role than they need to in Europe or North America. It is not laissez-faire passivity that will help so much as a discriminating use of government stimuli to encourage, not to restrict or interfere with the desired private sector activities. This is more or less what one finds in the fastest growing economies that do not benefit from oil exports, ranging from a large one like Brazil to the smaller Asian states--South Korea, Taiwan, Hong Kong, Malaysia, Singapore--to such African countries as Kenya, Malawi and Ivory Coast.

This notion of an activist but facilitating policy is a subtle concept, one which will require different interpretations for different cultures and situations. We in the United States are accustomed to an emphasis on financial rewards and competitive markets; we are not uncomfortable with an assumption of selfishness in motivation--as a general common denominator. Our system of rewards is certainly not perfect or foolproof, but it works out to serve the public a good deal of the time. Elsewhere some of these aspects may be questioned, and different emphases would be appropriate. In U.S. tradition, businessmen are well respected; in some other traditions, public officials or the military may have higher social esteem as well as political position. In such societies the contributions of people who organize productive activities and provide services need to be more fully recognized, for it is they who supply the substance of developmental growth. But whatever the differences in shading of the policies most appropriate for stimulating active growth in different countries, a few salient points would seem to apply generally.

One is to beware of an automatic assumption that if something needs doing it must necessarily be the government which does it. Governments must, in most developing countries, participate in major decision-making, but they may do better in many cases to take their distance from the actual administration of economic enterprises, even though they support the purposes involved. The temptation to control everything from the center should be resisted in the interests of fostering a spirit of self-confident initiative, even though it can mean that the more independent private managers may make some mistakes which might have been avoided under centralized control. The process of learning-by-doing is extremely important to development--especially under a definition of development as what people can do (rather than what they have). In the longer run a system of decentralized control, working indirectly through stimulus and reward to desirable initiatives, will be more creative, will produce a wider spread of human capabilities than would the effort to make everything go "correctly" through centralized controls. This is at the heart of the case for private enterprise, stated in positive terms.

Some readers may feel that this is all very fine and idealistic, but it does not fit the realities of greedy human nature. If one does not keep an eye on the activities of private individuals engaged in "nation-building" enterprises, it may be said, they will break all the rules and grab what they can for themselves. Numerous examples of improper self-enrichment may be cited to reinforce this view of what can be expected. The issue raised here is not so much that of how cynical one needs to be about human nature as it is the use of a double standard. If selfish actions are predicted from private individuals, this could legitimately be predicted also from individuals in the public sector. Again, numerous real-life cases of improper self-enrichment by public officials may be cited. Who is going to watch whom?

The case for private enterprise, when stated in more negative terms, is that both public and private sector individuals can be expected to show a good deal of selfish motivation. Nations that find dynamic, idealistic leaders to carry them through important transitions are, to that degree, fortunate; but most of life consists of non-dramatic daily events and relatively ordinary people. If unusual idealism is not to be relied on, the question becomes one of whether the selfish motives of private decision-makers are likely to do more for society than those of public managers. Obviously one needs some people working in both sectors in any country, but there is room for choice in the emphasis that one or the other is given in developing new economic activities. And the argument for private enterprise is that private profit can serve society, that the discipline of producing to please one's customers better than another producer, and of finding new activities that will become profitable, are pressures with important social value.

The outcome of selfishness in government officials, on the other hand, is more questionable. Ambition may well induce them to pursue important national goals with vigor, to be sensitive to the needs of groups whose support they need for advancing a career, and to refrain from improper behavior for fear of exposure. But the urge for money and power can also have results harmful to society which are well known and need not be spelled out. And these descriptions apply to leaders and would-be leaders, while most public actions are taken at lower levels of the civil service, where less ambitious forms of selfishness prevail. The government clerk or middle-level functionary, whose activities provide the counterpart to a small-scale private firm manager, is chiefly interested in his security, and--especially in inflationary environments where civil service pay falls behind prices--in some extra income; he may develop skill in knowing and manipulating complex regulations, in ways of helping his friends, etc. Under the right supervision this motivation can be useful in promoting dependable service, but it may also work very much the other way; and the rewards and punishments for government personnel are most often determined on grounds irrelevant to the furthering of national development.

The motivation of ordinary people in government is too often omitted from consideration in ideological discussion. Socialist writings and speeches, in particular, tend to ignore any motives of public employees; government is just taken for granted as an instrument that can and will carry out whatever the author or speaker would like to see happen. In Marxist analyses, antagonistic class interests are insisted on under capitalism; but with socialism, the existence of a ruling bureaucratic class which could have its own interests and compulsions is never recognized. This line of thought seems quite unrealistic, and indeed wishful--it would be splendid if governments were run by persons of divine wisdom whose orders were perfectly carried out, but this seems unlikely. So, with the prospect for fallible human beings manning both the public and private sectors, the case for private enterprise rests: partly on the greater utility of selfish motivation in the private sector; and partly on the positive gains for building and diffusing developmental skills and experience when control and responsibilities are decentralized. Greater dynamism and innovation, along with market discipline, are to be expected.

This subject cannot be concluded without some mention of income distribution, although it can only be treated briefly here. One of the major criticisms of a capitalist system relying on private enterprise is that it favors the rich over the poor. (The word capitalist by definition suggests someone rich who can invest money and get a return from it; one does not usually think of the local shoe repairman as a capitalist--which he is.) There does appear to be a tendency toward greater income equality in the purely socialist countries, and also in the poorest countries where nobody has very much; the greatest inequalities are found in middle-income countries where there is an important mineral export like oil, or where landholdings are highly concentrated. In general, the middle and lower-middle income countries with mostly mixed economies show greater income concentrations at the top of the scale than do the Western capitalist countries. So the association of capitalism with income inequality is a lot less clear than is sometimes thought, but it is not zero.

If private enterprise economies are more dynamic than socialist economies in the longer run, as argued above, and if this is because success in meeting the demand of the public for goods and services is better rewarded in the private system, does that mean that income inequality is the necessary price for dynamic growth? Many people believe that it is, and that this price should be paid in the interests of a nation's future. Others may find that the price is too high, and opt for egalitarian policies, identifying their view of development with progress for the poor even at a cost to national growth rates. The former group would object that the poor will be better off in the end with higher growth, even if they have to wait longer for the benefits to arrive. The egalitarians, aside from applying a different

moral standard, may feel that a generation is too long to wait for an uncertain outcome. This kind of argument will not be settled here.

In my view, the overall distance between major income classes is not exactly the key to growth--after all, some of the champion growth rates are found in countries like Korea and Taiwan with unusually equal distributions. What matters more is how an individual gets ahead, whether it relates to his contributions to development goals. The presence of extremes of wealth and poverty usually implies an important share of inherited wealth in an economy, and this will fail to stimulate either rich or poor to put forth greater efforts. But lack of stimulus also results from generalized income equality unaffected by performance levels. There must be some degree of reward and punishment in order for income stimulus to take effect--which implies at least moderate differences in income levels, and for individuals there must also be the possibility of moving up. This mobility also implies some possibility of moving down, and therefore a degree of insecurity. Above all, the achievement of income improvements should result from productive work, and not simply from political power or monopolistic position.

In many of today's mixed economies, some of the larger private incomes have their origins in governmental favoritism and regulations, like favored access to scarce import licenses or to permissions to conduct a business with a monopoly situation. Where this is true, such incomes should be attributed to governmental actions rather than to private endeavor per se. True, the private businessman no doubt actively sought the privilege, and may have paid bribes to get it; but there would be no bribery unless there was a government-created monopolistic privilege to be sought, and an official ready and eager to get paid. This consideration does not take care of all the moral questions involved, but it has a bearing on the impression that some people get of private business having some association with ill-gotten wealth.

As a general proposition, one may state that any enterprise holding a monopolistic position, whether it is a private or public enterprise, will be less likely to strive to serve the public than it would if the public had other suppliers to whom it could turn. A monopolistic enterprise is also likely to extract higher prices, and to pay higher salaries to its officers for less work, than the same enterprise would if it had to face competition. And it is generally true that state enterprises try to achieve and are often given monopoly positions in some field. Thus, monopoly is the enemy of progress, and also of equal opportunities and equity in income distribution. If monopoly is associated with private enterprise, then the remedy is not to replace it with an even more comprehensive socialist monopoly, but to stimulate more and more private enterprises to challenge it with more competition in its services to the country.

A few policy implications of this way of looking at development may be noted in conclusion. Every country has its own history, institutions, and particulars in its current situation, so these ideas may have more applicability in some situations than in others. What can be stated in general terms is the following:

If development means the accumulation of human skills and capabilities conducive to economic growth, then the stimulus of producers and managers to greater efforts and to a greater search for useful innovations deserves priority for achieving developmental progress. Therefore, incentives are important; and among these, one of the most reliable and best understood for policy purposes is the economic incentive. To tap economic incentives for the benefit of society, there must be differential economic rewards resulting from productive contributions. Such rewards can be expected from the competition of private producers, provided the market is not too greatly biased by monopoly privileges. This danger is most effectively countered by policies which encourage producers to enter into fields where increased goods or services are in demand, and where profits are probable.

The means for such encouragement are many: banking policies which extend credit to new and small entrepreneurs, not just to established firms; government support for training opportunities, ranging from university subjects to practical skills, coupled with some form of apprenticeship arrangements; systematic study by government of unfamiliar technical alternatives and new fields, together with methods for disseminating such findings to would-be private users--whether in extension networks to small business (analogous to agricultural extension) or more sophisticated communication of more advanced technology; and a minimum of the usual "red tape" requirements for licensing and approval of new firms. Actions that can result in monopolistic privileges should be avoided. Where state enterprises exist, a government should sell its shares in such enterprises to private persons and use the money from sales to help finance new enterprises. Beyond this, an activist government will be on the lookout for new markets for its country's products and unfamiliar products it might be able to make, and also for unusual policy devices that have served as successful stimuli elsewhere. The objective in all this is to provide its people with the self-confidence resulting from successes in "learning by doing."

In Africa, Asia, and Latin America, the DIGEST is distributed through the U.S. Agency for International Development to persons with a professional concern with the development process. Requests for copies should be directed to the AID mission or, if there is no AID office, to the U.S. Embassy.

Readers in North America, Europe, Japan, Australia, and New Zealand, may purchase the DIGEST from the U.S. Government Printing Office. An annual subscription (4 issues) is \$7.90 in the U.S., \$7.90 plus \$2.00 mailing charge elsewhere. Single copies are \$2.00. A discount of 25 percent is offered on purchases of 100 or more. Subscription order, enclosing payment, should be sent to:

Superintendent of Documents  
Government Printing Office  
Washington, D.C. 20402

Agency for International Development  
Washington, D.C. 20523

AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID  
AGENCY FOR  
INTERNATIONAL DEVELOPMENT  
SPECIAL FOURTH CLASS RATE BOOK



